List of

United States, British and German Patents

Covering Compositions and Substances Entering into the Manufacture of Glass

MOCK AND BLUM

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Covering Compositions and Substances Entering into the Manufacture of Glass

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Preface.

The glass industry in this country has ably responded to the unusual demand made upon it in the last few years because of the conditions arising from the war, and it is to be expected that it will permanently produce in this country articles heretofore almost exclusively imported. In any event conditions prevail ing before the war will not prevail for many years to come.

This compilation of U. S., British and German patents has reference only to the chemical side of glass manufacture. The patents relate not to the machinery employed in connection with the manufacture of glass, such as glass blowing machines, but are concerned with the compositions and substances that enter into the manufacture of glass, that is, more especially with glass formulae. The compilation of such glass patents for U. S. is complete up to Jan. 1, 1919, for Great Britian is complete from 1855 to July 1, 1918, and for Germany is complete up to the end of 1914.

Some of the topics treated of in these patents are as follows:

Coating hollow objects; producing glass of various colors including black glass, and also glass having a dull lustrous appearance.

Producing strong and tough glass, and glass resistant to chemicals and acids; preventing the formation of air bubbles in glass; producing glass suitable for strong bottles for containing charged waters or the like; producing glass that can withstand sudden changes of temperature; producing glass for globes or bulbs.

The specifications of U. S. Patents have been reproduced in full. The claims of U. S. patents still in force are not given in full, but the characteristic claim or claims are reproduced. Where it is desired to get copies of all the claims of the U. S. patents this can easily be done by remitting five cents to the Commissioner of Patents.

As the U. S. glass industry has for the future determined to set itself free from all foreign dominance and standards, it is hoped that this compilation will do something toward that end.

MOCK and BLUM.

Hugo Mock.
Asher Blum.

New York, March 1, 1919.

Index of Names of Patentees and Assigns.

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Subject-Matter Index.

NOTE: This also includes the ingredients or substances. These have been indexed under the names referred to in the respective patents, as a matter of convenience to the reader, so that the same substance or chemical compound may appear in this index under more than one name. Where an ingredient is mentioned several times in a patent, it is only referred to once in this index for that patent.

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UNITED STATES PATENTS.

No. 7,145. Improvement in the Composition for Enameling Hollow Ware. Paris and Paris, Mar. 5, 1849.

Our invention consists of a new and useful composition for coating articles made of either wrought or cast iron, so as to keep off the atmosphere and other fluids and matters which would cause the iron to oxidize.

In order that our invention may be most fully understood and readily carried into effect we will proceed to describe the means pursued by us.

In the first instance the articles to be coated with this new composition are, whether made of sheet-iron in the form of vessels, trays, pipes, or otherwise, to have their surfaces cleansed by dilute acid, as is well understood, and dried, and then a coating of gum dissolved in water is to be laid on the surfaces by means of a brush or otherwise, and then the vitreous composition is to be sifted all over the surfaces. The nature of this composition will be described. The article is then to be introduced into a heated oven or retort (212° to 300° of Fahrenheit) to be dried, and when dry the article is to be removed into another retort heated to a bright red heat till the glassy composition or vitreous matter melts on the surface, which will readily be seen by looking through a hole in the cover of the retort or oven. The article is then to be removed into a close chamber or covered over with a cover to exclude as much as may be the action of the atmosphere till the article is cooled down. If on examination the coating is imperfect another is to be added in like manner to the first.

The vitreous composition which we use is as follows: One hundred and thirty parts of flint glass reduced to powder; twenty and one-half parts of carbonate of soda; twelve parts of boracic acid. These matters, being intimately mixed, are to be placed in a glass-maker's crucible and melted. The same is then to be drawn off and cooled and then broken down into fine powder, which is to be sifted through a fine sieve—say seventy holes to the inch—and this powder is to be applied as before described. We would remark that although we believe the above to be the best vitreous composition for the purpose, we do not confine ourselves to the above-mentioned proportions therefor, as the same may be varied.

It is important in preparing the vitreous composition that it should be free from foreign matter. For this purpose we employ hardened steel stampers for crushing the same into powder, and before employing the crucible we cause it to be coated with glass by applying gum water to the inner surface of the crucible, and then dusting over the powder of glass, and after the same has been well dried we cause the same to be heated gradually up to the heat which fuses the glass, by which the surface of the crucible will be coated with glass, and will thus when used prevent impurities from the crucible getting mixed up with the glass or vitreous mixture melted therein.

If it be desired that the surfaces of the iron should have a colored vitreous composition applied thereto, then we cause it first to be coated with the composition above explained and afterward we apply a further coating of colored glass composition to the whole or parts of the surface as may be desired.

No. 204,384. Improvement in the Manufacture of Glass from Lava. Shirley, May 28, 1878.

My invention relates to an improvement in the manufacture of glass; and it consists in adding to flint

glass, as a flux, lava or volcanic slag in suitable proportions, so as to produce a glass which is capable of being blown, and which, when robbed of its glaze by the bath or other suitable treatment, will present a dull lusterless appearance, so as to adapt it especially for the imitation of antique ceramics, mosaic and lava pottery ware, and cheap reproductions of the works of ancient masters, as will be more fully described hereafter.

In the manufacture of my glass, I take seven parts of clear flint batch, and add thereto one part carbonate of potash or its equivalent and two parts of lava or volcanic slag. This slag, being mixed with vitreous impurities, mixes with and colors the mass so as to produce various tints and colors, which may be varied according as the proportions of the above ingredients are changed. When the melted mass is in proper condition for working, it is blown or otherwise molded into any shape that may be preferred, but is especially adapted for making copies of antique vases and urns and copies of works of art.

If desired, regular glass, except clear flint and plain white or opal glass, which decolorizes the coloring mixture, may be used and colored with the necessary chemicals to produce the required and various colors, and to render the same opaque either by coating or backing with such dense coloring matter as vitrified cobalt, taffee, calcined vitrol, or their requisite equivalents for the several colors required. These substances are used as a substitute for the lava.

As the various articles produced will have a glaze and newness of appearance that unfit them to represent ancient works of art, they are subjected to the action of a suitable bath or any other process known to the art, whereby the glazing is entirely removed, and only a dull lusterless appearance is left. Should it be desired to have the glaze remain upon certain parts, these parts may be protected from the action of

the bath in any suitable manner, or these parts may be afterward reglazed by any suitable compound. Upon these parts may be engraved any suitable figure or design, or be fixed upon the parts in colors and fused to the surface. Gold and gilt decorations of all kinds can also be applied, and gold can be placed in the indented lines so as to produce a very handsome effect.

By thus mixing lava and glass, I produce a new compound which is capable of being blown as readily as glass itself, so that any form that is capable of being formed in that manner can be reproduced very rapidly. Instead of carbonate of potash, any other flux may be used, or a flux may be entirely done away with, if so preferred.

No. 210,331. Improvement in the Manufacture of Milk or Alabaster Glass. Kempner, Nov. 26, 1878.

The object of the present invention is to dispense with the use of whitening materials heretofore employed in the manufacture of the kind of glass known as "milk glass," "fusible porcelain," "alabaster glass," "cryolite glass" or "opaline," these materials being generally phosphate of lime, peroxide of tin and cryolite.

In carrying out my invention, I combine with the ordinary glass materials—soda, potash and sand—a mixture consisting of feldspar, fluor spar and heavy spar, or instead of the latter, witherite, in the manner and proportions hereinafter mentioned.

The mixture generally used and added to the glass materials, and fused therewith, consists of feldspar, twenty to seventy-eight parts; fluor spar, seventeen to sixty parts; and heavy spar, five to forty parts: One hundred parts of this mixture are added to the glass mass, consisting of ten to seventy parts weight

high grade soda, or fifteen to one hundred parts weight of potash, and seventy to three hundred parts weight of sand.

In the fusion of the materials it is advisable to maintain the soda scum in a stable state, and to regulate the greater or less consistency of the mass by increasing or lessening the scum which collects at the rim of the fusing pot. The admixture of heavy spar ($BaSO_4$) will increase the density and polish of the glass; but care must be taken that the glass is not made too dense by a too large use of the heavy spar. It will be found that four parts weight of heavy spar are proportioned to five parts weight of soda, or six and a half parts weight of potash, in order to produce the most satisfactory quality of glass possessing the requisite characteristics of density, polish and high refracting power.

Glass produced in the manner mentioned at once possesses the required milky or semi-translucent appearance, and in the molding, blowing or other manipulation thereof it does not require to be rewarmed, as it cools or sets less rapidly than glass made in the ordinary manner.

I may state that I use the ordinary decoloring means employed in processes for producing glass of the present description; and, furthermore, I add charcoal to five to six parts of the heavy spar.

I also propose to employ, instead of this last- mentioned material, and in connection with the other ingredients heretofore mentioned, the material known as "witherite" ($BaCO_3$) in the same proportions as the heavy spar is used. Three parts weight of witherite are proportioned to five parts weight of soda, or six and a half parts weight of potash. When witherite is employed it will not be necessary to use the charcoal as above mentioned.

No. 270,991. Compound for the Manufacture of Glass. Sindell and Stewartson, Jan. 23, 1883.

This invention relates to certain improvements in the manufacture of glass, and it has for its objects to provide an improved vitrifiable composition of matter, and to produce a new article of manufacture, which besides possessing the characteristics of glass, will be more solid and less brittle, and will be adapted to many purposes for which the ordinary glass is not applicable.

Our improved composition consists of sand, soda, clay, lime and salt. These, in a finely divided state, are thoroughly mixed and commingled, and are melted together, either in a furnace or in the usual glass-pots heated in the ordinary glass furnace until a homogeneous fluid compound is produced. When thus mixed, melted and combined, coloring materials—such as the protoxide of copper, black oxide of copper, or other mineral oxides—are added to the mass to produce the desired tint or color.

In carrying out our invention we have found the ingredients in the following proportions to answer well for general purposes, viz: sand, one hundred parts; soda, fifty parts; clay, one hundred parts; lime, twenty-five parts; salt, twenty-five parts. These, as before stated, are thoroughly mixed and melted in a proper furnace or crucibles, and when melted the materials to impart color to the mass are added, as before mentioned, and the whole is worked subsequently, in the same manner as ordinary glass, for the formation of various articles by blowing, moulding, casting, and otherwise. The material thus produced may be conveniently formed into building blocks, ornamental vases, slabs, tiles, and, in fact, may be applied to all purposes to which stone and glassware have heretofore been applied.

Slate in combination with vitrifiable compounds has been heretofore employed in the manufacture of glass,

but such will not produce the variety of glass that we obtain by our invention, and we make no claim to glass having slate as an ingredient.

No. 285,436. Composition of Matter for the Manufacture of Glass, Shepard, Sept 25, 1883.

A black shale found in the lower coal measure, generally above No. 3 coal vein (Pennsylvania Geological Survey), and elsewhere, one hundred parts; soda ash (carbonate soda), ten parts; lime (burned), thirty parts; salt (chloride sodium), twelve parts; arsenic, one-fourth part. These ingredients, pulverized and intimately mixed, I melt and treat as in the ordinary process of glass manufacture. The product is a very beautiful, strong, black glass, soft to work, and useful for all purposes for which glass is generally employed, not requiring the transmission of light.

I prefer the foregoing combination; but the shale may be used without soda ash and with other fluxes and ingredients, or with these in other proportions, and the product will be the same or similar.

I am aware that the manufacture of black glass is old; but I believe that it has never been made from the shale combined with the materials as above described. The advantage of my invention is the production of a superior quality of black glass at a cost much less than any ever before made.

No. 288,056. Glass for the Manufacture of Water Drain and Sewer Pipes, Higley Nov. 6, 1883.

My invention has for its object to produce an exceedingly hard, strong and tough glass, which is especially adapted as a material from which to make water drain and sewer pipes, and for a variety of other purposes, where great strength and durability are required; and my invention consists in glass composed of silica, slag from smelting furnaces, porphyry, potash, lime, rock salt, oxide of lead, sal ammoniac, and

alum mixed and fused together, as hereinafter more particularly set forth.

In carrying my invention into effect I take fifty parts of silica, fifteen parts of slag from smelting furnaces, crushed or pulverized, ten parts of porphyry, crushed or pulverized, ten parts of potash, five parts of unslaked lime, four parts of rock salt, three parts of oxide of lead, two parts of sal ammoniac, and one part of alum, and place them in a suitable receptacle and thoroughly mix and incorporate them together in the usual manner, after which the compound thus formed is placed in an ordinary crucible used in making glass and fused, when it is drawn out into molds or worked in the same manner as ordinary glass.

The proportions of the above-named ingredients may be slightly varied, if desired, without departing from the spirit of my invention.

The above described glass can be made of any color desired by the addition thereto of any of the well known coloring substances adapted for the purpose.

The employment of porphry, which is an inexpensive ingredient, renders the glass exceedingly strong and tough and capable of withstanding blows and hard usage without fracture, besides giving it a brilliant appearance. The sal ammoniac and potash render the glass less brittle, and consequently much more durable than ordinary glass, while the rock salt accelerates the operation of fusing the ingredients together and tends to prevent the formation of air bubbles in the mass.

Glass composed of the materials above described is comparatively inexpensive, as but a very small proportion of oxide of lead is used, which substance is one of the most expensive ingredients heretofore used in the manufacture of glass; and my improved glass is on this account particularly adapted for use in the manufacture of water drain and sewer pipes, and for an infinite variety of other purposes where a clean

hard surface is required combined with great strength and durability.

No. 295,410. Process of Manufacturing Glass. Knaffl, March 18, 1884.

My invention relates to a new process of manufacturing glass by the use of phosphoric acid, and the production of a new article of glass.

Heretofore in the manufacture of glass it has been necessary and the custom to use such ingredients as silica, boric acid, potash, soda, lime and lead.

The object of my invention is, first to provide a process of manufacturing glass by the use of phosphoric acid and dispensing with ingredients heretofore used in the manufacture of glass; second, to furnish, as a new article of manufacture, a glass composed of few ingredients, having superior qualities, readily produced, and formed in any desired shape and easily amalgamated with metals. I attain these objects in the following manner:

I take a quantity of boiling aqueous solution of ortho-phosphoric acid and add to it granulated metallic zinc so long as the zinc continues to dissolve with the development of hydrogen gas. This will form a mono base of zinc phosphate. This mono base of zinc phosphate is then neutralized with caustic baryta or strontium or calcium oxides or other suitable neutralizing agents. (I prefer, however, to use caustic baryta.) By this neutralization is formed the three-base zinc baryta phosphate. I then evaporate this three-base to dryness and subsequently melt it in a suitable vessel to a cherry-red heat, which, when in a fluid state, will be my new glass in a melted condition, and can be poured into any form or shape for future use, or can at once be moulded or made use of, the glass thus formed being a poly-phosphate, or my new glass. After the melted mass has hardened, it can by the application of heat be remelted into its

former liquid state, to be used for any purpose, the heat required being a much lower temperature than that required to melt glass manufactured by the old methods.

Some of the striking advantages of my new glass are that it contains no silica, boric acid, potash, soda or lead; it is of higher luster and has greater refractive powers than other glass, thereby being of great value for optical purposes; it is perfectly white, clear and transparent, and can be ground and polished; it is insoluble in water and neutral, and can be attacked only by hydrochloric acid or nitric acid, and cannot be affected by hydrofluoric acid, as is the case with other glass; it is easily fusible in the flame of a candle, and can be made of any color; it is of such a nature that it can be readily amalgamated with metals, and can be used for glazing articles of glass or porcelain, metals, or other materials.

No. 309,741. Manufacture of Obsidian Looking-Glasses. Rosenzi, Dec. 23, 1884.

My invention relates to an improvement in the manufacture of obsidian looking-glasses, and it consists in the employment and use of ferroline, a material of which the composition was invented by myself, and is protected by Letters Patent No. 244,486, granted to me on July 19, 1881, instead of obsidian, used by the Romans and Greeks in former ages for looking-glasses and reflectors on astronomical instruments.

The obsidian is known to be a kind of glass produced by volcanoes, and composed of ingredients similar to those employed in making and compounding ferroline. As described in the said patent, the component parts of ferroline are soda, silex, ashes, lime, magnesia, borax and arsenic, and the same have been found in obsidian. The high degree of polish of which the ferroline is susceptible qualifies it above

other materials for looking-glasses, and its deep black color gives it a peculiarly attractive appearance. The mass obtained by the proper intermixture of the ingredients named is cast or blown into plates of any desirable form and thickness—flat, concave or convex—and polished and framed to fit the place it may be destined to occupy.

The advantage gained by substituting ferroline for obsidian consists in its cheapness over the volcanic production and in its adaptability to all forms and sizes. The perfection and beauty of these looking-glasses can only be appreciated by examination. Nothing of the kind has ever been offered to the public. The reflections are as clear and distinct as seen in the brightest glass mirrors, but subdued by a tint that gives the reflected image a peculiar charm. Ferroline may also be used for reflectors, and will be found of great brilliancy, but deprived of the glare reflected by metal, so offensive and injurious to the eye.

No. 332,294. Manufacture of Glass and Articles Therefrom. Shirley, Dec. 15, 1885.

My invention and discovery consist, first, in a new mixture for glass, whereby I produce a new translucent glass, which, when formed into articles, shows entirely new and beautiful effects; secondly, in new articles of manufacture from such glass; thirdly, in applying certain finishes to same, as more fully described hereinafter.

To carry out my invention I take one of the regular glass mixtures technically known as "lead" or "flint" glass, consisting, say, of one hundred (100) pounds avoirdupois white sand, thirty-six (36) pounds refined lead oxide, twenty-five (25) pounds of pearl ashes, five (5) pounds bicarbonate of soda, seven (7) pounds of niter. I make this translucent in any usual way, say by adding six (6) pounds of fluor spar and

five (5) pounds of feldspar. This batch produces a well-known mixture for translucent or opal glass, and my new mixture consists in a batch of this sort, to which both gold and uranium, or its described equivalents, are added, whereby a new glass is produced, as more fully described below. To a batch such as above described I usually use two pounds avoirdupois of oxide of uranium and one and one-half pennyweights of prepared gold. the whole to be thoroughly mixed and melted in the usual manner known to the art. The proportions above mentioned may be varied, if desired, or equivalents substituted without departing from the spirit of my invention and discovery, which is the combination of the oxide of uranium with prepared gold, added to glass mixtures containing alumina, or its equivalent, when compounded, so as to form a translucent glass—for example, the fluor spar and feldspar (both of which contain alumina) may be omitted and cryolite and kaolin (which also contain alumina) substituted in equivalent proportions, care being taken to prevent the body being made too dense.

Articles of glassware when made from this melted mixture will have a beautiful sulphur-yellow color throughout when first formed, but in finishing same in the usual manner in which such articles are made, the metal or material will develop a delicate pink shade on the portions last finished, this color shading into the original yellow body color. Should it be desired, the workman by reheating the edges to a melting point can restore the original yellow color on the part so reheated, thus producing varied effects of color shading not previously obtainable.

My invention is the specific combination of a distinctive coloring agent—such as oxide of uranium with prepared gold—and adding same to glass mixtures, which form a translucent glass body and contain alumina, or its equivalent, this last named material having a special effect on mixtures containing

gold, controlling the sensitive action of its coloring property in a marked degree. One peculiarity of my mixture when melted is that where the color is once developed on the article is not sensitive to change from subsequent reheatings, unless the heat is carried to such a high degree as to partially melt the glass, and another peculiarity is that the pink or developed color by such increased heat can be reduced, and the part so reheated to its original yellow color, the workman taking care to keep the article in form by using his tools in the usual manner. The tint of yellow may be varied materially from a very pale primrose with a slight greenish tint to a deep sulphur yellow by increasing or diminishing the uranic oxide, and the pink or developed color may be varied in like manner from a pale salmon color to a deep rose by adding to or decreasing the proportion of gold; but, if the latter is increased too much, the shades of color will not be so delicate, and it will prevent the reaction of the developed color to its original body color. Carbonate of copper or oxide of chrome, combined with litharge, may be used in lieu of the oxide of uranium with the prepared gold, and the above described translucent glass mixture and beautiful translucent glassware of other colors shading into each other can be produced, and combination of other oxides with the uranium and gold would give still other varieties of color, the first-named carbonate of copper producing ware of delicate greens to pale blue (shade of color being dependent on quality used), bodies shading purple and rose color, that is developed in the finishing. The chrome oxide and litharge produce a shade of yellowish green, shading into a maroon or purple. When the mixture is melted in the pot, the workman will gather sufficient metal on his blow-iron to form the article desired, and proceeds in identically the same manner well known to the art, and as if making the same shaped article from ordinary flint glass, and without any care or

effort on his part the shaded effects described will be produced, and the article when finished will be annealed in the usual manner. I also produce a new and beautiful effect on this ware by removing the skin or glazing from the surface of the article, either entirely or in parts only of the same, by abrading same with a sand blast or immersing the articles in a bath suitable for that purpose. When desirable to retain the glaze on any portion, such parts are to be protected by a suitable cover or shield, or covered with wax or varnish, and the articles of this glass can be further ornamented by enamel colors, its resistance to heat without change of color rendering it specially adaptable for this purpose, as enamel colors require a high heat to flux them. When carbonate of copper is used, the best proportion is nine ounces; for chrome and litharge, two ounces green oxide of chrome and ten pounds of lithrage well mixed with same, and it will also need an increase in amount of gold. The effects can be varied, as will be understood, by using a mixture of these coloring agents.

I am well aware of the so-called "opalescent mixtures" that change in the working,and which contain bone ash and also tin, in combination with arsenic, and that the same have been combined with coloring oxides to produce whites, greens and blues. Most of these have a flinty appearance with opalescent tints, and when reheated develop shaded colors from the body color to a white, the developed color being more or less opaque. These all turn in the working by cooling and reheating the article, and are all well known to the art for many years. I do not claim these; nor do I include manganese, which is frequently used as a corrector in all glass mixtures, in the term "distinctive coloring oxides" for although, if used in excess, it would give a body color, it would not be suitable for practical use with gold, and is not the equivalent practically of uranium, copper or chrome

and lead, and would not produce a color in contrast with that developed from the gold, and is well known for many years to have been used in combination with gold in coloring glass.

No. 360,840. Batch for Making Glass. Adams, April 12, 1887.

My invention relates to the composition of an improved batch for the manufacture of glass, in which the sulphate of soda is used; and it consists, mainly, in forming the same in part of coal or sawdust.

The composition of the batch as ordinarily used by me consists of sand, one hundred parts; sulphate of soda, forty parts; ground limestone, thirty-five parts, or burnt lime, twenty-seven parts; arsenic, two parts; coal, three parts. The coal used may be either bituminous or anthracite, but I prefer the former. Sawdust may be used instead of coal, and while not so good, in my opinion, is still an equivalent of the coal, and as such I wish it to be understood as included under the head of coal used in the claims. These ingredients are all mixed together to form the batch before it is put into the melting pot or hearth. The effect of the coal or sawdust is to produce a prolonged ebullition, caused by the driving off of the volatile matters, and this tends to clarify the bath. Moreover, the action of binoxide of manganese contained in the coal is to counteract the effect of the oxide of iron which exists as an impurity in the other ingredients.

I do not limit myself to the exact proportions of the batch given, nor to the particular batch so far as the coal is concerned.

I am aware that charcoal and coke have been used as ingredients in glass batches. My invention differs from this, however, in that I employ coal, sawdust, or similar substances containing volatile hydrocarbons, which under the action of heat are converted into gases and produce the ebullition in the batch, which is the purpose of my invention to secure.

No. 468,723. Producing Opalescent Glass. Kempner, Feb. 9, 1892.

This invention is a new process derived from melting experiments for producing opalescent glass. Said experiments have demonstrated that fluorides of alkalies alone do not produce opalescent glass, which fact is also established by other tests (*vide* Dingler's Polytechnisches Journal, Vol. 256, p. 361, 1885); that even cryolite produces opalescent glass only if added in a large proportion; that, however, silicofluorides of alkalies (silicofluoride of sodium or silicofluoride of potassium) or compounds thereof, when added in a relatively small quantity to a glass batch of any suitable composition, produce an intensely opalescent glass. I have found that when adding to three equal batches of the same composition, respectively, ten grams of fluoride of sodium, cryolite and silicofluoride of sodium the first two mixtures resulted in a perfectly clear, white glass, but the third mixture containing silicofluoride of sodium in a completely milky opalescent glass.

When making batches for an opalescent glass in glass works, the proportion of silicofluoride of alkali to be incorporated will naturally depend on the nature of the substances constituting the glass batch on the temperature of the furnace, and on the degree of dullness desired to be produced. If, for instance, in an ordinary cryolite opalescent glass batch consisting of thirty units of cryolite, forty-six units of carbonate of soda, twelve units of chalk and one hundred and sixty-five units of sand, the cryolite is replaced by twenty-five units of silicofluoride of sodium and eventually twenty units of kaolin, a glass perfectly equal to cryolite opalescent glass is obtained. The kaolin, however, is not absolutely necessary, but any other aluminiferous mineral may be substituted therefor, as it merely serves to produce a glass similar to cryolite.

Silicofluorides of alkalies may also be advantageously employed for enriching any opalescent glass batches. In the batch above referred to, for instance, fifteen units of the cryolite contained therein may be replaced by silicofluoride of alkali. The batch, which would then be composed of fifteen units of cryolite, forty-six units of carbonate of soda, twelve units of chalk, one hundred and sixty-five units of sand, and twelve and a half units of silicofluoride of sodium, results in an opalescent glass which is at least as good as if only cryolite had been employed. The action of the silicofluoride of alkali is quite different from the action of a union of the ingredients constituting chemically the silicofluoride of alkali. With the exception of cryolite it is impossible, owing to the absolute absence of other raw material, to use anything but silicic acid as source of silicium. Silicic acid, however, melted together with bases will never result in anything but silicates of bases, no matter whether or not a fluor compound is present. For a combination, for instance, to silicic fluoride of sodium a reduction to silicium would be required, which, however, is known not to occur under these circumstances. Consequently fluosilicates of alkalies are only obtained by chemical combination of fluosilicic acid with an alkali or by alternate decomposition in solutions, but never by the combination of the elements silicium, fluor and sodium. Especially fluosilicate of alkali has never yet been obtained by the action of high temperatures on mixtures of compounds of silicium, fluor, and alkali. Such colliquefactions, therefore, do not result in fluosilicate of alkali, as, when melting the said compounds together, no hyperfluoride of silicium is produced, while with dry heating of fluosilicates of metals hyperfluoride of silicium escapes. It is just the energetic action of this gas constant at a high temperature on the other constituents of the glass bath which effects the addling.

Therefore, no hyperfluoride of silicium escapes when smelting together compounds of silicum, fluor, and alkali, the addling process, according to my method, is totally different, as in my process the hyperfluoride of silicium is the most essential part.

No. 479,689. Manufacture of Rose or Orange Stained Glass, Welz, July 26, 1892.

My invention has relation to the manufacture of colored glass; and has for its object the provision of means whereby a permanent color may be imparted to the glass without reheating or staining by dipping the finished articles into glass containing gold salts.

The invention relates more particularly to the manufacture of colored glass the tint of which varies from a rose to an orange or orange-red color; and it consists, essentially, in the admixture with the molten glass of selenium or of selenium and cadmium sulphide. If selenium alone is added and incorporated with the molten glass, the latter assumes a rose color, the depth of which can be varied by varying the proportion of selenium. On the other hand, the proportion of selenium for a given depth of color will depend upon the composition of the viterous mass, which composition differs for the various grades of glass.

To distinguish the rose-colored product, I have called it "créme-rose" or "rose-cream."

If cadmium sulphide is combined with the selenium and the mixture added to the molten vitreous mass, the latter will assume a red-orange color, the shares of which, ranging from orange-red to orange-yellow, will depend upon the proportion of cadmium sulphide used with the selenium, the color changing from orange-red to orange-yellow as the proportion of cadmium sulphide is increased relatively or the selenium used. In order to distinguish this product, I have called it "créme-orange" or "orange-cream." It

is obvious that the proportions of these substances to be incorporated with the molten vitreous mass cannot well be given, for the reason that these will greatly vary, according to the depth of color to be given to the final product.

The molten vitreous mass, colored as described, can be worked at once into any desired article, and does not require either reheating or staining, the color being also permanent.

No. 494,636. Composition of Glass. Jensen & Keck, Apr. 4, 1893.

Heretofore in the manufacture of glass an expensive item has been the English soda used as a base. We have discovered that by using a rock termed "phonolite," which contains considerable alkalies, instead of quartz sand, an addition of carbonate of soda can be entirely dispensed with. Phonolite is found in considerable quantities in our country, and it consists more or less of sixty per cent of silica, twenty per cent of alumina, and fourteen to fifteen per cent of potassa and soda. German green glass, which until recently could not be made in the United States, is made by the addition of an average of twenty-two per cent of limestone to the rock "phonolite." Light green or light amber glass for window glass or fruit jars requires with the rock an average of forty per cent of sulphate of soda and two per cent of saltpeter. The use of this rock "phonolite" for bottle glass, enables the manufacture of a very strong glass adapted to stand the strong pressure that champagne, mineral and soda-water bottles are subjected to. A more fluid glass than the above-described may be obtained by mixing the rock with ten to twenty-two per cent of natural sulphate of sodium. Of course limestone has to be mixed with the rock, twenty to thirty per cent.

No. 518,336. Making Rose-Red Glass. Spitzer, Apr. 17, 1894.

This invention relates to the process, discovered in 1865 by the French chemist J. T. Pelouze, of staining glass in rose-red by the incorporation into the ordinary glass composition of free or so-called metallic selenium. In carrying out this process, the selenium is either added to the mixture of raw materials to be filled into the melting pot, or it is introduced into the already molten mass. There are two grave objections to this process, namely, a great part of the costly selenium becomes vaporized and burned under the action of the high temperature prevailing in the glass melting furnace, and the selenium of commerce is always accompanied by impurities such as copper, iron, &c., which interfere with the color of the glass and cannot be separated from the selenium except by a tedious process. According to my invention, these objections are overcome by adding either to the batch or to the molten glass composition consisting of silica, potash and lime suitable selenites or selenates instead of metallic or free selenium and by decomposing these salts by the introduction of a convenient agent after they have been completely dissolved in the molten mass. This agent may be arsenious acid, arsenite of soda, zinc dust, or other materials having similar effect, but in general arsenious acid is preferred. When selenite of soda Na_2SeO_3 and arsenious acid As_2O_3 are used two reactions take place. By the high temperature prevailing in the kiln oxygen is expelled from the Na_2SeO_3 and the selenide of sodium Na_2Se thus formed is, in presence of arsenious acid decomposed according to the following equation:

$$3Na_2Se+As_2O_3+3SiO_2=3Na_2SiO_3+3Se+As_2$$

The selenite of soda, Na_2SeO_3, is also decomposed by the silicic acid SiO_2 and the selenious acid freed there-

by is deprived of its oxygen by the arsenious acid, which takes place according to the following equations:

$$Na_2SeO_3 + SiO_2 = Na_2SiO_3 + SeO_2.$$

$$SeO_2 + As_2O_3 = Se + As_2O_5.$$

It is obvious however that the said salts and separating agents may be introduced together. I thus replace the easily inflammable metallic selenium by substances, which are very steady under high temperatures, and in preparing the selenites or selenates of the selenium of commerce, the impurities are necessarily at the same time eliminated. Consequently a better result is obtained at less expense.

In practice I find it preferable to use the selenites or selenates of alkalies or alkaline earths; it is obvious, however, that other salts of selenious or selenic acid may be used provided that the bases of these salts do not give a wrong color to the glass. The selenites or selenates chosen, which in most cases will be the potassic, sodaic or calcic salts, are either mixed with the batch or added to the molten glass mass, and in both cases the molten mass is well stirred up in order to obtain a uniform distribution therein of the dissolved salt or salts. The separating agent may be arsenious acid, arsenite of soda or potash, sulphite of soda, &c., but in general zinc dust is preferred. The reducing agent is either mixed with the selenite or selenate or introduced separately, and in both cases the mass is stirred up after the addition. The selenium separated in this way gives the desired rose-red color to the glass.

The quantity of selenites or selenates to be added to the glass composition or to the molten glass depends on the desired depth of color to be given to the glass, and is best found out by a preliminary experiment on a small scale. In most cases two or three parts by weight of the selenites or selenates will suffice for thousand parts by weight of glass.

No. 522,001. Composition For Manufacturing Glass. Ayling, June 26, 1894.

The main objects of my invention are to produce what is generally known in glass manufacture as German green glass, to utilize for the purpose, waste or inexpensive materials and to produce a strong, tough metal suitable for bottles, battery jars, electric insulators, &c., and generally to improve the quality of glass for such articles.

It consists of the composition of matter hereinafter particularly described.

For the batch, I take clay, preferably in the form of pulverized or broken brick, ordinary sand, such as is commonly used in the manufacture of glass, and salt-cake (sodium sulphate), which is a by-product of the manufacture of hydrochloric acid, in about the following proportions by weight: one hundred parts of clay or broken brick, one hundred parts of sand and forty parts of salt-cake. The mixture composing the batch is then melted in the ordinary manner in crucibles or tank furnaces such as are commonly used for the purpose. A metal is thus produced which can be easily and economically worked and will produce glass of a uniform unvariable green and of superior strength and quality.

Heretofore it has been found difficult, if not impossible, in this country to produce with certainty, from inexpensive materials at least, the color known as German green, which is desirable for certain purposes such as the manufacture of certain kinds of bottles. With my improved composition as above described, the desired color can be invariably obtained. By varying the proportions of the ingredients, different shades of green can be produced, but if the quantity of sand is increased, the salt-cake, which serves as a flux, should be correspondingly increased. I prefer, however, to employ the several materials

in about the proportions above stated, as I have found by experience that they give uniformly satisfactory, if not the best results.

The clay which I have thus far employed is such as is found in the vicinity of Milwaukee, Wisconsin, from which Milwaukee cream-colored brick are made, but I do not wish to limit myself to this special variety of clay, as other kinds may serve the purpose equally well. Imperfect and broken brick made from suitable kinds of clay, are preferable when they can be had, because they are in better condition than the clay for melting. In places where brick are made extensively, sufficient quantities of such waste material can be had for little or nothing.

Inasmuch as all of the materials entering into my composition are usually obtainable as waste products, glass can be made therefrom very cheaply and of excellent quality.

No. 552,091. Composition for Manufacturing Glass. Ayling, Dec. 31, 1895.

This composition is suitable for manufacturing "amber" bottle glass.

This is made of one hundred and forty parts of sand, seventy parts of finely crushed, broken or pulverized furnace slag, which is composed mainly of silicate of lime, and seventy parts of salt-cake, which is a by-product of the manufacture of hydrochloric acid and fifty parts of clay. When mixed and melted in the ordinary manner, this produces a strong, tough glass of a reddish-brown color. The most suitable clay is found near Milwaukee, Wis., and which is used to make Milwaukee cream-colored brick. The clay may be omitted.

No. 576,312. Means for Decoloring Glass. Hirsch, Feb. 2, 1897.

For decoloring glass while in a molten state metals or metal compounds have been used, such, for instance, as antimony, nickel, zinc, lead, or the oxids of such metals. Furthermore, acids have been used, such as arsenious acid, also minerals, such as pyrolusite or manganese, and salts, such as saltpeter; but I am not aware that selenium has ever been made use of for decoloring glass while in a molten state.

My invention consists in the use of selenium or selenium compound, such as selenite or selenate, for the above-mentioned purpose.

I am well aware that selenium or selenium compounds have been proposed as means for coloring glass, and I refer to the publication of T. Pelouze in the *Comptes Rendus,* Vol. LXI, page 615, October, 1865, and of the German Patents Nos. 63,558, 73,348, 74,565, and 77,737. In all these publications it is set forth that selenium may be used for coloring glass either rose-red or orange color, but in no instance is reference made to the use of selenium or selenium compounds for decoloring purposes. Now, in view of the fact that not every known means for coloring glass is *per se* means for decoloring glass, and, furthermore, that not every known means for decoloring glass will be suitable for coloring glass, my invention is based on the discovery which I have made that selenium is in a very high degree suitable for the decoloring of glass. I have found by repeated experiments that by adding a very small quantity of selenium to the molten glass I may convert the glass of a dark shade into a white and bright glass of very fine appearance. The less dull the molten glass, especially if materials of a better class have been used for its components or ingredients, the smaller may be the quantity of selenium for decoloring the same

and for obtaining white glass. Again, glass molten with potash will require a smaller addition of selenium than glass molten with soda or Glauber salt. I have found by experiments that with a quantity of glass for which one hundred kilograms of sand and the necessary quantity of flux have been used about one to five grams of selenium may be used for decoloring the glass.

Experiments have proved that the same composition of molten glass for the decoloring of which nickel has hitherto been used will deliver a much whiter glass if selenium be used for decoloring. The selenium may be used as metallic selenium or as a selenium compound or composition or in the form of a gas. It may be used as a selenite, that is to say, a salt composed of selenious acid and an alkali, or as a selenate, that is to say, a salt composed of selenic acid and an alkali. The selenite or selenate may be added to the dry glass frit or may be added to the molten glass and well stirred thereinto. When such a compound is used, suitable agents for setting free the selenium in the glass must be employed. These agents may be such as are well known for the freeing of the selenium from the selenite or selenate in the art of coloring glass with selenium; for example, arsenious acid or arseniate of sodium or potassium or sulfite of sodium. The said agents are added to the molten glass after the selenium compound has been dissolved therein.

Another method of using the selenium for decoloring the glass is to add it in the form of cullets of glass containing selenium.

It may be preferable in some cases to cause a preliminary decoloring of the molten glass or a simultaneous decoloring of the same by adding other decoloring agents to the molten glass, such, for instance, as metallic nickel or oxid of nickel, saltpeter, or arsenic, and to obtain the higher degree of transparency or whiteness by means of adding selenium.

No. 607,003. Composition of Matter For Manufacturing Glass. Van Fleet, July 5, 1898.

The object of my invention is to produce for use in the arts a material suitable for many or all of the uses to which glass is applied and for uses to which ordinary glass cannot be applied because of brittleness, said material being superior to common glass in its freedom from liability to fracture.

My invention also has for its object to produce a glass especially adapted for use as an insulating material for electricity and which, owing to its strength and freedom from fracture under sudden and extreme changes of temperature, is particularly applicable for employment in connection with engines driven by gas, gasolene, or other inflammable matter for the generation of electricity, and also in connection with other electric appliances where insulators are needed of greater strength and higher insulating qualities than those now known.

My newly invented glass is a vitreous product which is characterized as containing a silicate or silicates, magnesia, alumina, and water, combined with a suitable flux, and which is in structure amorphous, noncrystalline, and free from grit. Such a product is distinguished from common glass by its superior strength, superior electrical insulating qualities, and absolute freedom from fracture under sudden and very great changes of temperature. The material may be heated to any temperature up to fusing and instantly cooled, in whole or in part to zero, without fracture.

The principal ingredients of the composition are as follows, compounded in the proportions named: silica, 46.19; iron protoxid, 4.70; iron oxid, 2.24; magnesia, 12.57; water, 10; alumina, 8; soda and potash, not estimated separately; approximately 14.50. These ingredients I have found existing in about the proportions stated in an ore produced from a mine lo-

cated near Claremont, in Los Angeles county, California, which is known in that locality as "green-paint ore." The silica exists in the ore as a silicate that is chemically combined with the bases magnesia oxid (MgO), iron oxid (FeO), &c., and does not exist as free silica or sand. The ore is distinguished as follows: Cleavage, imperfect; fracture, uneven; hardness, 2 to 2.5; flexible when wet; brittle when dry; color, dark serpentine green with some blue; luster, glistening, slightly subvitreous; smooth and unctuous to touch; free from grit; specific gravity, 2 to 2.5; structure, smooth non-crystalline.

To the above-named constituents, whether taken as the ore in its natural state or combined artificially, after the same have been suitably pulverized, is added a flux, preferably composed of litharge in about the proportion of two and one-half per cent of the whole mixture; commercial borax, two and one-half per cent; soda (bicarb.), one and one-half per cent. When such flux and the foregoing principal ingredients have been suitably mixed and fused, they will form a composition that may be defined as a combined hydrous silicate of magnesia, alumina, iron, soda and potash, having a suitable flux.

It is to be understood that various other well-known fluxes and combinations of fluxes may be used instead of the flux which I have named, and that the proportions may be varied, and also that the analyses of various specimens of ore may vary, the essential characteristics of the ore remaining the same.

The vitreous product varies in color, depending upon the character of the fluxes used. I have produced specimens much resembling green glass in appearance and other specimens varying in color from white to black. The material is smooth and shiny, and specimens which I have made will cut ordinary glass, and they bear a strong resemblance to obsidian and have a conchoidal fracture.

No. 703,512. Composition for Ruby Glass, Zsigmondy, July 1, 1902.

The requirements of producing a ruby glass adapted for pressed and blown glasswares are rather great. The glass must be sufficiently cheap, the process of coloring must take place regularly and during the work, and the color must appear in a sufficiently pure shade. The process of coloring as well as the melting in must be done without any by-process.

The present invention relates to a composition for ruby glass; and it consists of mixing barytiferous glass compositions with certain quantities of gold and then melting this mixture in a glass-furnace. By the use of gold and salts of barium, ruby glasses can be obtained which becomes colored during the work easily and completely in a brilliant shade, and the gold is made use of in such a way that its power of coloring is utilized in a most efficient measure. These glasses of baryta possess, with regard to other glasses, the just mentioned superiorities, it being supposed that they do not contain certain impurities that influence the processes of coloring in an unfavorable manner, and it is also supposed that unfavorable circumstances of firing in the furnace on melting in the glass do not prevent the after development of the color. Further, the proper proportion between silicic acid and gold is substantial. The experiments have shown that no less than 0.25 parts and no more than 1.7 parts of gold to ten thousand parts of silicic acid (quartzy sand) must be employed. When less than 0.25 or more than 1.7 parts of gold are employed, the glass loses the capability of becoming colored red during the work. On employing more than 1.7 parts of gold an undesirable result is caused by the precipitation of the gold. The most advantageous results are obtained with a proportion from 0.6 to 1.4 parts of gold to ten thousand parts of silicic acid.

The composition of the glass to which gold is to be added can be varied in different ways. For instance, it may be composed of silicic acid, alkalies, and baryta only, or other oxids (or oxygen-bearing compounds, as nitrates and carbonates) of bivalent metals may be added to or substituted for part of the alkalies or the baryta. A small addition of boric acid is allowed, too. However, an addition of an oxid of antimony or of manganese or of iron or of aluminium must be avoided because such an addition in some cases prevents the development of the color. The same disadvantageous effect is produced by the addition of a noticeable quantity of lime.

Good results have been obtained with glass compositions containing, as metallic oxids, soda and baryta only. The baryta may be introduced as oxid of barium, hydrate of barium, carbonate of barium, &c. However, the nitrate is to be preferred to the other compounds.

As an example of the proportions of mixture with which by the addition of gold a pure ruby glass can be produced the following may be stated: 1.66, chemical equivalents SiO_2; 0.288, chemical equivalents, Na_2O; 0.276, chemical equivalents, BaO; or 1.66, chemical equivalents, SiO_2; 0.41, chemical equivalents, Na_2O; 0.085, chemical equivalents, BaO.

Also mixtures lying between the above-stated proportions allow the production of a good ruby glass. With all these mixtures it is most advantageous to use from 0.9 to 0.75 parts of gold to ten thousand parts of silicic acid. The gold may be added to the other components in one of the usual forms, as a finely-divided metal or as a metallic compound—for instance, as chlorid—in a solution sufficiently diluted by water.

In order to produce according to the present invention blown articles, it will be preferable at first to cool down the glass—for instance, by blowing it into a

small mold or by cooling it with water and exposing it to the cold air. Then it should be rewarmed and blown in a proper mold.

The described colored glass may also serve for the production of molded glasswares.

I claim:

1. A composition for ruby glass consisting of a barytiferous glass composition to which from 0.25 to 1.7 parts of gold are added for every ten thousand parts of quartzy sand, substantially as described.

2. A composition for ruby glass consisting of a barytiferous glass composition which contains as substantial metallic oxids soda and baryta and to which from 0.25 to 1.7 parts of gold are added for every ten thousand parts of quartzy sand, substantially as described.

No. 777,334. Process of Making Translucent Opal Glass. Kempner, Dec. 20, 1904.

In my process I make the opal glass of sand, soda, feldspar poor of lime, and sodium silico fluorid.

In the process known till now the opal glass was made by adding alkaline silicofluorid to the usual glass-frit (alkaline lime silicate); but this addition causes difficulties, having a detrimental influence on the opalescence and the fusibility of the glass-frit. If no lime is added, then a suitable quantity of alumina must be introduced into the glass-frit, as is already well known in the manufacture of opal glass through the use of cryolite (an element containing fluorin).

For the purpose of making in an economical way an opal-glass frit according to my invention the same is composed of sand, soda, feldspar poor of lime, and sodium silicofluorid, the two later constituents in the proportion of two to one; but the feldspar of the mixture may amount to three-fourths and the sodium silicofluorid may sink to one-fourth. A suitable composi-

tion of a glass-frit is one hundred parts of a mixture of feldspar and sodium silicofluorid, one hundred and sixty to one hundred and eighty parts of silicic acid, and thirty-seven and one-half to fifty parts of soda. The choice in the sand and soda addition is to allow for the difference of temperature occurring at times in the oven.

The glass-frit mixture is suitable for a feldspar of the following composition; silicic acid, 68.15 per cent; alumina, 18.58 per cent; potash, 8.90 per cent; soda, 3.45 per cent; lime, 0.77 per cent; magnesia, 0.11 per cent; water, 0.04 per cent. The use of alumina in combination with sodium silicofluorid in manufacturing opal glass is already known; but such a glass-frit was never entirely free of lime.

Having now described the nature of my invention, what I claim is—

1. In a process of making opal glass the use of a glass-frit composed of sand, soda, feldspar poor of lime and sodium silicofluorid the latter in the proportions of two to one, as and for the purpose specified.

2. In a process of making opal glass the use of a glass-frit composed of one hundred parts of feldspar and sodium silicofluorid, one hundred and sixty to one hundred and eighty parts of silicic acid and thirty-seven and one-half to fifty parts of soda, as and for the purpose specified.

No. 845,552. Manufacture of Glass Articles. Jonkergouw, Feb. 26, 1907.

The manufacture of glass articles has been effected hitherto by melting at a high temperature the raw material used and subsequently molding or blowing it while hot, so as to give the molten matter the desired shape.

This invention relates to process in which the molding takes place while the material is cold.

Broadly stated, the invention consists in preparing a mixture of materials which is capable of being converted into glass by the application of heat, molding these substances, thoroughly mixed, when cold, and then submitting them to the action of heat while still in the mold.

The substances used are as follows: Fontainebleau sand, carbonate of soda, borax, chalk and minium. Fontainebleau sand may be replaced by any other suitable sand or by quartz reduced to powder. Carbonate of soda may be replaced by carbonate of potash to which may be added a small quantity of nitrate of potash. The proportions in which these substances are mixed together may vary, as will be readily understood, in accordance with the transparency of the product to be obtained. By way of example, the following proportions could be used: Fontainebleau sand, 608; minimum, 300; carbonate of soda, 50; borax, 12, chalk, 30; total, 1,000. To the mixture thus constituted may be added, further, one thousand parts of Fontainebleau or other suitable sand.

Compositions may be employed in which the proportion of Fontainebleau sand is as low as three hundred parts in one thousand, and the mixture may be employed without further addition of Fontainebleau sand.

The above are intended as limit figures. Any proportions comprised within these limits may be usefully employed.

The different substances are thoroughly mixed together in the shape of powder, and coloring-matters may be added—such. for instance, as oxid of cobalt for obtaining blue color, oxid of gold for obtaining red color, oxid of copper for obtaining green color, etc. The mixture is then placed in a suitable furnace and for about two hours exposed to a temperature of 1,500° to 2,000°. If the frit is not very fusible, it is simply placed on the hearth of the

furnace. If, on the contrary, it is very fusible, it can be placed in a vessel, so as to prevent the frit from flowing. When the frit is sufficiently burned, it has the form of paste and is cast into water. It remains there in the state of paste and can be kept for any length of time. It is in this form that it is subsequently used, as will be seen later on. If the frit is very fusible, it is cast dry. The paste thus obtained is subsequently ground very fine. Water can be added to facilitate the grinding. It is then screened, the grade of the screen or the sieve used depending on the fineness of the powder it is desired to obtain. For ordinary paste the screen No. 120 can be used, and for very fusible paste screens up to No. 90 could be used. The excess of water contained in the paste is then removed by drying in the air. In this way by the above-described method of preparation a series of pastes of different colors is obtained, the color depending, as already stated, on the metallic oxid added to the mixture at the moment of the formation of the frit. It will be readily understood that since these pastes have to be molded cold, as already stated, the chief drawback to be avoided is the sticking of the paste to the mold after the burning. It was therefore necessary to find a mold of special composition preventing sticking of the paste to the wall of the mold during the burning. Such a mold comprises as its main constituents a mixture of clay, kaolin, quartz and burnt plaster, the latter product preventing the sticking and the other products forming plastic supports. The proportions of the said substances may vary. The following proportions give in practice very good results: clay, two; kaolin, two; ground quartz, two; plaster, four. For preparing molds from this composition the substances are mixed together, and owing to their plasticity they can be easily given the desired shape for constituting molds. These molds are then burned at a temperature of 1,000° to 2,000°. After burning they

are slowly cooled and then tempered in lime-water. The molds are, moreover, always kept in the said lime-water, so that they should have a certain moisture at the moment of use.

To make a glass article by means of one of the said molds, the mold is taken from the bath of lime-water and the bottom of the mold decorated with frits of various colors obtained as described, or with ordinary enamels or with a mixture of frits and enamels. Over the decoration is heaped lightly a white paste or paste of one or even of two colors, according to circumstances, so as to fill the mold completely. To facilitate the placing in the mold of portions of frits of different colors, according to the ornamentation that the article is intended to possess, brass grates could be used, forming compartments in which to place the frits of different colors. After the frits have been put in place the brass grates are removed before placing the filling-frit. Instead of the brass-grating the frits of various colors can be arranged either by means of a brush or by hand. The mold thus containing the raw material is then introduced into the mold with oxidizing or reducing atmosphere and heated, according to the fusibility, from 750° to 1,000°. The burning operation lasts about two hours. Then the mold is removed from the furnace and the articles can be removed from the mold without difficulty after cooling. In these conditions and according to the nature of the frits used articles completely imitating ceramic articles or vitrified articles having the absolute transparency of glass are obtained. These articles, according to the decoration or ornamentation made at the moment of molding, will be of one or many colors, with opaque colored parts, obtained by means of frits or with transparent colored parts, obtained by means of enamels.

When it is desired to have an article with very fine grain, the molding can be effected under pressure. In

these conditions the desired cohesion is given to the frit by quick burning and the said frit compressed while hot in a metal mold (brass or cast-iron). In these conditions an article is obtained having the same appearance as those obtained by the process hereinbefore described, but having a greater density.

I claim—

1. In the manufacture of glass articles, the operation consisting in preparing a glass composition, calcining the same, pulverizing the calcined material, placing the pulverized material while cool into a mold, then heating the pulverized material in the mold and forming the object therein by fusion, and removing the object from the mold after cooling.

2. In the manufacture of glass articles, the operation consisting in melting a mixture containing silicious matter and carbonate, pulverizing the frit thus obtained, placing the pulverized material while cool into a mold, then heating the pulverized material in the mold and forming the object herein by fusion, and removing the object from the mold after cooling.

3. In the manufacture of glass articles, the steps which consist in mixing together sand, minium, carbonate, borax, and chalk, fusing said mixture, grinding the frit thus obtained, placing the ground material while cool in a mold, and then heating the ground material within the mold, and forming the article by fusion therein.

No. 851,317. Opaque Glass. Reinmann, April 23, 1907.

This invention has reference to the production of a novel opaque glass and the process of making same.

It is the special object of my invention to produce a new opaque glass which is a close imitation of alabaster.

The new product is a white delicately tinted fine grained glass resembling alabaster, but, being a glass, is not soft as the mineral alabaster and therefore may be used for many more purposes particularly exterior decorations and such articles which are subject to atmospheric conditions and moisture. Not only the pure white variety of alabaster may be imitated, but the clouded varieties may be also colored for certain purposes.

The new alabaster glass is particularly adapted for making inner and outer globes for arc lights to hide the arc and diffuse the light and for making other bulbs. All kinds of ornaments heretofore made of alabaster may be made of the new glass by blowing, pressing or casting them. For instance some household utensils such as finger-bowls, dishes and vases are made from the glass and in this instance the composition may be tinted with traces of cobaltum or copper oxids. The first named will produce a bluish tint and the second a greenish tint as is well known.

The opaqueness of the novel glass is imparted thereto by admixing finely powdered and sifted asbestos and in some instances a certain percentage of talcum. The asbestos renders the glass imperfectly transparent or translucent and when some talcum is added a more dense and non-transparent glass is obtained which is rather impervious to light. It is essential for obtaining a perfect product to have a certain composition in combination with the asbestos and care must be taken that the glass is fused in a closed pot. In an open pot the opaque quality of the glass may not result because it may be burned out.

In carrying my invention into practice I substantially proceed as follows: First the various ingredients are weighed and mixed. The composition consists of pure white sand, soda, asbestos, arsenic, niter, and in some instances of talcum. The preferred percentages of the various components are as follows—Pure

white sand, 100 pounds, carbonate of soda, preferably of 90%, 42 pounds, finely powdered and sifted asbestos, 20 pounds, arsenic, 1 pound, pure niter, 4 pounds. When these ingredients have been thoroughly mixed they are fused in a closed pot in the usual manner. The cover which closes the pot in the front may be removed from time to time to watch the process of melting. When the composition has been completely transformed into glass and the desired opaqueness obtained the front cover is removed. Now, the glass is worked up into the desired articles.

For finger-bowls, dishes, vases and the like some cobaltum or copper oxid is admixed in the well known manner for the purpose of obtaining the bluish and greenish tints above referred to. For producing a more dense non-transparent glass up to 20 pounds of finely powdered talcum may be mixed with the percentages of ingredients above stated. The composition is then melted in the closed pot as above described.

In order to economize and make use of the cullet or scrap of the fused alabaster glass remaining from previous days the said scrap is admixed to the composition before it is fused. To the quantity of substances above given such cullet or scrap of alabaster glass may be admixed thereto up to 50 pounds.

It is obvious that the percentages of the various ingredients of which the imitation alabaster or opaque glass is composed may be varied within reasonable limits without departing from the spirit of the invention.

In the described manner I have produced artificial alabaster, white or colored, which does not share the deficiency of the mineral alabaster, that is, its softness. On the contrary my novel substitute alabaster is hard because it is a glass and therefore may be used for a great many more purposes than the mineral alabaster and lasts longer. The articles made from the

artificial alabaster are easily produced by blowing or pressing them in the same manner in which glass is worked up.

I claim:

1. The composition for artificial alabaster an opaque glass consisting of pure white sand, soda preferably of 90%, finely powdered and sifted asbestos, arsenic and niter substantially in the proportion specified.

2. The composition for artificial alabaster an opaque glass consisting of pure white sand, soda preferably of 90%, finely powdered and sifted asbestos, arsenic and niter substantially in the proportion specified, and tinting metallic oxids.

3. The composition for artificial alabaster an opaque glass consisting of about 100 pounds of pure white sand, 42 pounds of soda preferably of 90%, 20 pounds of finely powdered and sifted asbestos, and 4 pounds of niter.

No. 965,860. Composition of Matter to Be Used in the Manufacture of Glass. Bernasconi, Aug. 2, 1910.

This invention relates to improvements in imitation leaded glass, and has for its object the production of a composition for forming the outlines, which when fired will unite with the glass and resemble strongly leaded outlining.

According to this invention, the composition consists of a mixture of china clay, glass flux, and black enamel. With this is mixed a little adhesive such as gum arabic by which it can be caused to adhere to the glass. The outlining may be applied to both sides of the glass, which is then fired or baked in a kiln, causing the composition used for the lines to fuse. When fired the lines harden and unite with the glass.

For the composition of the mixture of which the outlining is composed the following proportions have been found suitable: 1 part of hard black enamel, known to the British glass trade as No. 31 F. 2 parts of china clay No. 100. 1¾ parts of glass flux known to the trade as No. 157 F. The hard black enamel above mentioned is composed of silica, potash, borax, manganese and black oxid of copper. The china clay is the best white china clay used for china. The glass flux is a compound of silica, borax, potash and lead. These are thoroughly mixed but the composition will not adhere to glass well by itself. To overcome this it is mixed with gum arabic and water, a sufficient quantity being used to enable the mixture to adhere to the glass in any desired quantity until the glass is "burnt." The gum arabic is only used as an adhesive.

In carrying out the invention a sheet of glass of any suitable kind is placed over a design, and the mixture traced on the glass over the design, in any suitable manner. For instance, it may be applied with a stick, brush or tube. A sufficient quantity is applied to makes the lines stand up, after which the glass is allowed to dry when it can be turned over and the opposite side similarly treated. When thoroughly dry the sheet of glass is placed in a cast iron tray and bedded down on a bed of plaster of Paris, and is then covered by a lid, which leaves a clearance of about four inches. Thus a large body of air is interposed between the glass and the lid, enabling the firing to be effected slowly in the well known manner.

Preferably the kiln is formed with a view hole so that the condition of the glass can be examined from time to time. As soon as the lines turn to a dark gray color the glass can be removed and it will be found that the lines have set hard, having exactly the same appearance as the partitions used in leaded glass. Conveniently the kiln is so constructed that the tray containing the glass, directly it is heated, can be re-

moved from the back of the kiln and a fresh tray inserted and so on continuously.

In making colored glass the stains are applied to the surface of the sheet of glass either before or after the outlining has been done and preferably such stains are chosen as fuse at the same temperature as the mixture used in the lines, as has hitherto been proposed. If desired, however, the proportions of the composition of the mixture may be varied to make it fuse at the temperature of the stains. The stains can be applied to either or both sides of the glass enabling different shades to be obtained.

By the use of the composition above described both sides of the glass can be treated without damage to the composition before it is burnt, or during the process of burning.

It is found that with this composition the glass ready for firing may be embedded down upon plaster of Paris or the like without the composition adhering to the bed. This is a point of great importance as it enables both sides of the glass to be treated equally well, and obviates the necessity for standing the glass on edge, which causes it to warp.

Obviously the rate of firing may vary according to circumstances, but preferably it is somewhat slow. Again, the composition of the mixture may be varied without departing from the invention. The above proportions have been found to effect the purpose satisfactorily.

I claim:

1. The herein described composition of matter comprising black enamel (consisting of silica, potash, borax, manganese, and black oxid of copper), china clay, and glass flux (consisting of a compound of silica, borax, potash and lead), substantially as and for the purpose described.

No. 974,801. Composition of Vitreous Matter. Krause, Nov. 8, 1910.

My invention consists in a new composition of matter, of which a conspicuous utility is in the formation of gas-tight thermally or electrically insulating joints between metal and glass or other insulating material, or between two metal members. This composition of matter is adapted to be applied especially to metals, such as iron or steel, and will be so applied in a fused or viscous condition under heat.

The vitreous substance or composition which is to serve as a coating or lining for metal, or which is to establish efficient hermetical union between two surfaces, especially when one at least is a metal surface, or which is to unite two metallic members, must be susceptible of application in a molten, that is to say, a fluid or viscous condition; and it should possess in appreciable measure the following properties, to wit: First. It should be capable in the fluid or semi-fluid condition of dissolving the oxid of a metal to which it is applied, so as thus to cleanse the metallic surfaces for the purpose of intimate and perfect contact with the vitreous composition. Second. It should freely wet the surface to which it is applied. Third. It should have a co-efficient of thermal expansion which approximates to that of the substance to which it is applied, in order that, on cooling or when in use the united members are subjected to fluctuations of temperature, the vitreous composition may preserve its own integrity and the intimacy of union with the member to which it is applied. Fourth. It should be mechanically strong, tough and preferably adhesive in respect to the materials to which it is applied. Fifth. It should fuse at moderate temperatures, not only for the sake of ready application but also so as to reduce as far as possible in the process of application that temperature interval during which strains are likely to be established. Sixth. In case the composition is to be

used to join together two members which have decidedly different thermal co-efficient of expansion, as a rule this composition to act as an efficient intermediary between such members should have a thermal co-efficient of expansion intermediate between the co-efficients of the members joined.

A composition of matter which constitutes a good example of my invention and which possesses the above recited properties in an unique degree, is constituted as follows: soda glass, 45%, borax, 45%, ferric oxid, 10%. These ingredients are fused together so as to form a homogeneous composition. The borax furnishes mechanical strength to the composition, renders it readily fusible at moderate temperatures, and contributes in a marked degree to the capacity of the composition to cleanse and wet a metallic surface when applied thereto in a fused condition. The ferric oxid contributes also to the toughness and ready fusibility of the composition, and renders it strongly adhesive to iron and kindred metals. Soda glass, as is well known, is composed chiefly of sodium and calcium silicate. Presumably the former ingredient is the more essential for the purposes hereinabove indicated, and therefore the calcium silicate might well be replaced by some other silicate capable of forming a glass with the sodium silicate without seriously modifying the properties of the composition in respect to the peculiar utilities contemplated for it.

Iron belongs to a group of closely kindred elements ordinarily known as the iron group, of which the other metals are cobalt, nickel, chromium and manganese. The elements of this group manifest striking similarity in physical and chemical properties, both in their elementary state and in their compounds; they are adjacent to each other in the elementary series and have atomic weights lying in the narrow range between 52 and 59. A significant index of the close kinship between these metallic elements, is that they are

notably magnetic in character, exceeding all other elements in this respect. It is well known that members of the iron group on account of their similarity may replace one another, not only in many chemical processes, but also in compositions of matter, such as steel, without radically altering the character of the process or the qualities of the material. Thus, as might be expected, salts or the oxids of the other members of this closely related group will when employed in the above-described vitreous composition instead of ferric oxid lend to the composition properties similar to those conferred by ferric oxid.

By reason of its properties above alluded to, this vitreous fusible homogeneous composition is adapted for many useful purposes. By its aid a stout iron wire may be effectively sealed through a glass tube or bulb, a result never before accomplished so far as I am informed.

The proportions of the ingredients of this new composition of matter can, of course, be varied from the precise relative quantities above specified, and should be varied to suit the exigencies of different though related uses. For instance, if the vitreous compound is to be employed simply as a lining or coating for an iron or steel body, the formula given above is, I believe, to be preferred, whereas if the composition is to be used to join an iron or steel member to a member composed of ordinary glass, an effective composition may contain 65% of soda glass, 22% of borax and 13% of ferric oxide. Obviously in making such a composition of matter, a mixture of ferric borate and sodium oxid will produce as a result a homogeneous composition the same as with ferric oxid and sodium borate. Such reciprocal inversion of the ingredient compounds are indifferent so far as concerns the resultant composition.

I am aware that mixtures of soda glass and borax have been used for glazing iron; but these compositions lack both the strength and adhesiveness possessed by my new composition of matter, which is characterized by an ingredient salt of a metal of the iron group. I am also aware that some glasses or enamels have been made which contain small amounts of iron, cobalt or manganese, either as an impurity or as coloring matter; but in no case so far as I know have the proportions of such ingredients been sufficient appreciably to affect the mechanical properties of the glass or enamel, nor have they ever been capable, so far as I have known, of exercising the functional capacities which my new composition of matter possesses and which may be exploited for the purposes above suggested.

I claim:

1. A vitreous homogeneous composition composed chiefly of sodium boro-silicate and containing further the oxid of a metal of the iron group in proportions sufficient to manifest in the composition when fused a superficial intimacy with iron or kindred metal.

2. A vitreous homogeneous composition composed chiefly of sodium boro-silicate and containing further the oxid of a metal having an atomic weight between 52 and 59 in proportions sufficient to manifest in the composition when fused a superficial intimacy with iron or kindred metal.

3. The composition of soda glass, borax and ferric oxid, the last in proportions sufficient to manifest in the composition when fused a superficial intimacy with iron or kindred metal.

No. 990,606. Material for Use in the Manufacture of Glass, Sullivan, Apr. 25, 1911.

In the present practice of the manufacture of lead glass, the lead is uniformly introduced into the glass as lead oxid—either litharge or minium. These are expensive materials and difficult to handle without the formation of dust and consequent injury to the health of the workmen. Some other lead salts have been proposed as substitutes for these oxids, such as lead sulfate, white lead (lead carbonate), and even lead sulfid in connection with sodium sulfate to decompose it. None of these substances, however, have been practically successful, in so far as I am aware.

In an application for Letters Patent of the United States, of even date herewith, I have described a method of incorporating lead into glass in the manufacture of lead glass, by using as the direct source of the lead, the cheap natural lead sulfid or galena (PbS), the most common ore of lead. In carrying out said method, the native lead sulfid ore (galena) is first purified by washing, jigging or other mechanical or chemical operations, so as to remove from it, in particular, any iron minerals associated with it. The purified lead sulfide is then mixed, in proper proportions, with a difficultly fusible material (for instance a substance containing combined or uncombined silica, such as pure sand, or feldspar) of such quality as is suitable for glass making. A mixture of the lead sulfid and silica (or of the lead sulfid and feldspar), both of the required purity for a lead glass charge (excepting the sulfur present), is then roasted in any suitable form of roasting furnace, at the speed and temperature best adapted for removing the sulfur most completely from the roasted material. I have found, for instance, that by hand roasting a mixture of three parts by weight of pure sand to one part by weight of galena in a reverberatory furnace, at a temperature

rising to between 900 and 1,000 degrees centigrade, and allowing the roasting material to remain about twenty-four hours in the furnace, with stirring at intervals of one hour, the sulfur remaining has been reduced to 0.05 per cent, furnishing a practically pure lead product, pure enough to satisfy the very exacting requirements of the lead glass maker. The lead-bearing substance, which I thus produce is of a granular, non-dusty and sintered form. The small grains appear to be almost entirely of quartz, with a more or less irregularly distributed "pebble-dash" surface of lead silicate. Some of the grains carry more of silicate than others and the silicate shades into the quartz rather gradually, showing all graduations of concentration. At the outer surface, the silicate is apparently a pure component judging from its refractive index, and the roasted product as a whole appears clean, and sufficiently uniform for the purposes intended.

The lead-bearing substance, produced in accordance with the invention, is mixed with any other material appropriate to lead glass manufacture and the mixture is then fused down to lead glass. I have found that a suitable mixture for the purpose may be compounded of say the sintered lead product 40 pounds, pearlash 5 1/2 pounds, soda 4 1/2 pounds and niter 1 pound.

In compounding and thereafter handling, storing or transporting from one part of the works to another a batch made with lead silicate, the mixture is found to take on and maintain greater uniformity of distribution of the ingredients throughout the mass than when litharge is employed; for the reason, that the specific gravity of the lead silicate more nearly corresponds to that of the remaining constituents.

A further advantage to be gained by the use of lead silicate in the manufacture of lead glass is that it is free from metallic lead, which is present up to one-half of one per cent and more even in the best commercial litharge, and also to some extent in minium. This

metallic lead tends to give the glass a darker color, and, furthermore, it tends to shorten the life of the glass-melting pot by eating through the pot wall.

In manufacturing lead glass containing lime, the lime (used as lime, limestone or gypsum) may be mixed with the silica and lead sulfid and thus participate in the roasting operation. Or the lime, limestone or gypsum alone may be mixed with the lead sulfid and roasted therewith, the silica being introduced later in the glass-fusion operation; or the lime, limestone or gypsum may be excluded from the roasting operation and used only in the final fusion of glass. Such variations fall within the generic principle of my process, which is essentially to roast the lead sulfid thoroughly mixed with a difficultly fusible substance, under test conditions as to purity of the roasted product, and then to use this roasted product in glass making.

The lead-containing material or product itself resulting from the practice of the process, and hereinafter claimed, possesses great advantages as a means of introducing lead into glass. Its powder is practically without deleterious effect upon the workmen. The product dissolves in glass without any chemical decomposition, such as necessarily accompanies the use of lead sulfate, lead carbonate, or lead sulfid and sodium sulfate. Moreover, I have found that my lead-containing material dissolves quickly and uniformly to a more homogenous lead glass than can be obtained, so far as I am aware, by the use of any of the lead salts or compounds before proposed for use in glass making.

Having thus described my invention, what I claim is:

1. As a new material for use in glass making, the granular, sintered product obtained by dead roasting, to a percentage of not more than about .05 per cent of sulfur, a mixture of galena and a substance diffi-

cultly-fusible at the roasting temperature but suitable to the composition of lead glass; substantially as described.

2. As a new material for use in glass making, a granular substance consisting of fused or sintered lead silicate associated with silica and practically devoid of sulfur; substantially as described.

3. As a new material for use in glass making, a granular substance consisting of fused or sintered lead silicate associated with silica and a calcium compound and practically devoid of sulfur; substantially as described.

No. 990,607. Manufacture of Glass. Sullivan, Apr. 25, 1911.

As is commonly known, lead glass is glass containing up to fifty per cent of lead oxid combined with silica (SiO_2) and alkalis, such as potassa (K_2O), and is at present made by melting together lead oxid (either in the form of litharge, (PbO); or minium, (Pb_3O_4) with a pure sand and potash. The oxids of lead used for this purpose must be of a special purity, being made from special brands of best refined lead, and they command a high price. The manufacture of these oxids is a tedious and costly operation, deleterious to the health of the workmen. The handling and mixing of the lead oxids with the glass forming the charge is also accompanied by the escape of lead oxid dust into the air, so that poisoning of the workmen is not infrequent. Furthermore, the lead oxids do not dissolve rapidly and uniformly in the glass mixture and it requires the highest skill of the melter to produce glass of fairly homogeneous composition and density.

The object of the present invention is to incorporate lead into glass in the manufacture of lead glass, by using as the direct source of the lead, the cheap natural

lead sulfid or galena (PbS), the most common ore of lead. As at present practiced, this ore is first reduced by a complicated set of metallurgical reactions to crude metallic lead; the latter is then refined either by fire processes or by electrical refining; the refined lead of high purity is then oxidized in special furnaces to lead oxid; and finally, the latter is mixed with glass forming materials and melted together therewith to form lead glass as hereinbefore indicated.

My invention consists in first purifying, if necessary, the native lead sulfid ore (galena) by washing, jigging, or other mechanical or chemical operations, so as to remove from it, in particular, any iron minerals associated with it. This operation is, in general, cheap and easy to perform and involves no operation not commonly known and practiced in the purification and concentration of metallic minerals. The purified lead sulfid is then mixed, in proper proportions with silica of such quality as is suitable for glass making, or with any other suitable difficultly fusible substance, such as feldspar. This mixture of lead sulfid and silica (or of lead sulfid and feldspar), both of the required purity for a lead glass charge (excepting the sulfur present), is then roasted in any suitable form of roasting furnace, at the speed and temperature best adapted for removing the sulfur most completely from the roasted material. I have found, for instance, that by hand roasting a mixture of three parts by weight of sand to one part by weight of galena in a reverberatory furnace, at a temperature rising to between 900 degrees and 1,000 degrees centigrade, and allowing the roasting material to remain about twenty-four hours in the furnace, with stirring at intervals of one hour, the sulfur remaining has been reduced to 0.05 per cent, furnishing a practically pure lead product, pure enough to satisfy the very exacting requirements of the lead glass maker.

I believe that the strict conditions as to purity of the materials, and the high elimination of sulfur which my experiments have shown possible, are outside of any recorded facts or experience in the metallurgical roasting of galena ore, and that I am the first to demonstrate that a lead-bearing material, practically free from sulfur and sufficiently pure for glass making purposes, can be practically produced in the manner described.

The lead-bearing substance, which I thus produce, is of a granular, non-dusty and sintered form. The small grains appear to be almost entirely of quartz with a more or less irregular distributed "pebble-dash" surface of lead silicate. Some of the grains carry more of silicate than others and the silicate shade into the quartz rather gradually, showing all graduations of concentration. At the outer surface the silicate is apparently a pure component, judging from its refractive index, and the roasted product as a whole appears clean, and sufficiently uniform for the purposes intended.

In compounding, and thereafter handling, storing, or transporting from one part of the works to another a batch made with lead silicate, the mixture is found to take on and maintain greater uniformity of distribution of the ingredients throughout the mass than when litharge is employed; for the reason, that the specific gravity of the lead silicate more nearly corresponds to that of the remaining constituents.

A further advantage to be gained by the use of lead silicate in the manufacture of lead glass is that it is free from metallic lead which is present up to one-half of one per cent, and more even in the best commercial litharge, and also to some extent in minium. This metallic lead tends to give the glass a darker color, and, furthermore, it tends to shorten the life of the glass-melting pot by eating through the pot wall.

Throughout the entire operation, there is no grinding, mixing or handling of litharge or minium, thus avoiding lead oxid dust from those sources and its poisonous effects on the workmen. There are, moreover, only two operations necessary in passing from the purified ore to the glass. I believe, moreover, that the glass produced is more homogeneous than if made by attempting to dissolve free lead oxid in glass.

In manufacturing lead glass containing lime, the lime (used as lime, limestone, or gypsum) may be mixed with the silica and lead sulfid and thus participate in the roasting operation; or the lime, limestone or gypsum alone may be mixed with the lead sulfid and roasted therewith, the silica being introduced later in the glass fusion operation; or the lime, limestone or gypsum may be excluded from the roasting operation and used only in the final fusion to glass. Such variations fall within the generic principle of the process devised by me, which is essentially to roast the lead sulfid, thoroughly mixed with a difficultly fusible substance, under test conditions as to purity of the roasted product, and then to use this roasted product in glass making.

Having thus described my invention, what I claim is:

1. The method of manufacturing glass, consisting in roasting a mixture of lead sulfid and a difficultly fusible substance appropriate to the manufacture of lead glass, adding to the product of the roasting operation the other ingredients desirable in such manufacture, and fusing the final mixture to a glass; substantially as described.

2. The method of manufacturing glass, consisting in roasting a mixture of lead sulfid and silica, adding to the product of the roasting operation the other in-

gredients desirable in the manufacture of lead glass, and fusing the final mixture to a glass; substantially as described.

3. The method of manufacturing glass, consisting in roasting a mixture of lead sulfid, a silicious substance and a calcium compound (such as lime, limestone, or gypsum), adding to the product of the roasting operation the other ingredients desirable in the manufacture of lead glass, and fusing the final mixture to a glass; substantially as described.

No. 1,086,113. Vitreous Substance. Wolf, Burckhardt & Borchers (Assigned to Zirkonglass Gesellschaft), Feb. 3, 1914.

This invention relates to the production of a new or improved vitreous substance of the nature of quartz glass but of greater strength and less liable to devitrification and deformation when subjected to heat.

Quartz glass, as is well known, is obtained by melting pure natural quartz or silica free from water, which gives a vitreous substance having all the outward properties of glass but being different therefrom in its chemical composition, being a substance of pure acid character possessing great durability against chemical and thermal influences. Quartz glass, however, when subjected to high temperatures, tends to devitrify, that is to say, it transforms from the amorphous state into a crystalline state, in which condition it considerably diminishes in strength and may be crushed between the fingers. Moreover, when quartz is gradually heated to fusing point, it is found that it begins to soften at a temperature of about 1700° centigrade, which is somewhat below that of its fusing point. As soon as the softening point is reached, the quartz glass rapidly deforms, that is to say, rapidly loses its shape, and for these reasons quartz glass has been found deficient for many practical purposes.

The object of the present invention is therefore to produce a vitreous substance which, while possessing all the good qualities of quartz glass, will be of greater strength, being less liable to devitrification and deformation, thus enabling articles to be manufactured therefrom which shall be excellently durable against thermal influences.

According to the present invention, small quantities of one or more of the acidic oxids of the fourth group of the periodic system are incorporated with the quartz glass during its manufacture. These acidic oxids are very durable against chemical and thermal influences, but, of these oxids, the titanic and zirconium oxids are most suitable because of their high melting point and because their resistance to acids closely approximates that of silica. The oxids dissolve in the molten silica or form silicates therewith which dissolve in the excess molten silica and, owing to their high melting points, the fusing point of the mixture will vary but little and may even exceed that of pure quartz glass. It has been found preferable not to add more than 5 per cent of these oxids and that when the oxids are added to the silica in from fractions of one per cent to about 5 per cent, the liability of the product to devitrify is considerably less than that of pure quartz glass while, at the same time, the softening point is slightly higher than that of quartz glass and that when this softening point is reached, the product does not deform as rapidly as does pure quartz glass. The product is also capable of withstanding greater breaking strains and is also of greater durability against chemical influences than pure quartz glass.

It will be understood that either titanic oxid or zirconium oxid or both may be mixed with the silica prior to fusion.

The mixture of the silica and oxids may be fused in an electric furnace or by means of an oxy-hydrogen

or oxy-coal gas flame or the like. The vitreous substance thus obtained may be worked and treated in the ordinary manner.

We claim:

1. As a new composition of matter, a vitreous substance of the nature of quartz glass and derived from silica and a small quantity, not exceeding 5 per cent of an acidic oxid of the fourth group of the periodic system, characterized by its durability against devitrification and deformation and its capability of withstanding breaking strains and chemical influences.

2. As a new composition of matter, a vitreous substance of the nature of quartz glass and derived from silica and a small quantity, not exceeding 5 per cent, of a plurality of acidic oxids of the fourth group of the periodic system, characterized by its durability against devitrification and deformation and its capability of withstanding breaking strains and chemical influences.

No. 1,097,600. Method and Batch or Mixture for Making Illuminating Glass. Macbeth (Assigned to Macbeth-Evans Glass Co.).

The invention relates to a method and batch or mixture for making glass for illuminating purposes such as in electric and other shades and globes. It has for its primary objects, the provision of a process and batch which will produce a snow white glass which is not clear but which is translucent to a high degree and will transmit light without the reddish or yellow color known as fire, the glass in these respects distinguishing from the well known opal glasses which are either substantially opaque (and known as milk glass) or are to some degree translucent, in which case the coloring above referred to as fire is always noticed when light is observed through the glass; the provision of a process and batch which will produce a glass which transmits light better than the opal glasses and which

is subject to a minimum amount of breakage upon the application of heat, and the provision of a batch and process which will produce a glass having a white luminous appearance when transmitting light, with such light diffused in a pleasing manner restful to the eyes, and with a minimum loss of illuminating power.

In carrying out my invention I first take a batch or mixture somewhat similar to a batch or mixture used in the manufacture of colorless clear glass, the preferred ingredients whereof will be hereinafter more particularly pointed out, and to such basic batch or mixture I add substances, one of which is preferably oxid of aluminum and the other a fluorid, preferably fluorspar, although some other fluorid might be used. The use of the oxid of aluminum with this fluorid apparently produces throughout the glass minute specks, the larger of which are ordinarily visible to the naked eye, and which have the effect of diffusing or scattering the light and giving the glass its white luminous appearance. The specks in the finished ware are elongated in shape, and I believe them to be bubbles of silicon fluorid gas held in suspension in the material and elongated during pressing or blowing the glass into molds.

In manipulating the glass batch, the duration of operation and the degree of heat must be regulated so as not to entirely obliterate the so-called specks or bubbles, which obliteration appears to result when the heating is too intense or is carried on for too long a period. I therefore stop the heating operation at a time short of the production of complete transparency and the obliteration of the specks or bubbles from the glass, the glass tending to return to its colorless crystal stage if the operation is continued too long. In carrying out the operation I have found that good results are obtained in a furnace working at a temperature of approximately 2,700 degrees F., although this may be varied, and changes in temperature (as between 2,500

degrees and 3,000 degrees F.) may be compensated for, in a measure at least, by variations in the mixture or the length of time of the operation, which latter in many cases I have found to be less than twenty-four hours.

The specific combination of ingredients in the foundation or basic mixture or batch which I have found to give the best results is as follows:

Sand	100 lbs.
Lead Oxid	15⅝ lbs.
Soda	21⅞ lbs.
Niter	5½ lbs.
Salt	5½ lbs.
Borax	1¼ to 2½ lbs.

To the foregoing batch are added 18.12 pounds of hydrate of aluminum ($Al_2H_6O_6$) containing about 11.84 pounds of oxid of alumina (Al_2O_3) and six pounds of fluorspar (CaF_2). The materials are mixed together and fused as heretofore indicated.

The proportions of the oxid of alumina and the fluorid are not absolutely fixed, but may vary somewhat. The limit in the ratio of the fluorid to the oxid of alumina is reached when the resultant glass becomes an opal glass instead of a translucent glass without the fire characteristics of the opal glass. The relative proportions will also vary somewhat, depending upon the variations in the basic or foundation glass.

The glass produced by the present process is distinguished from other glasses containing fluorin, by the fact that the glass of the present process is translucent and yet without the characteristic known as fire of opal, whereas the fluorid glasses as heretofore produced were all properly definable as milk or opal glasses, being either white and opaque, or else partially opaque and showing with transmitted light a reddish or yellow color known to the trade as fire and bearing a resemblance to the color in natural opals.

What I claim is:

1. The herein described method of manufacturing illuminating glass, which consists in fusing together a foundation mixture capable of making substantially colorless clear glass with an aluminum oxid compound, and a fluorid, the quantity of the aluminum oxid compound by weight being greater than that of the fluorid, and the amount of aluminum by weight contained in the aluminum oxid compound being greater than that of the fluorin contained in the fluorid, and the heating operation being stopped before the glass returns to a clear glass stage and before the specks are eliminated.

2. The herein described method of manufacturing illuminating glass, which consists in fusing together a foundation mixture capable of making substantially colorless clear glass and including a chlorid, with an aluminum compound and a fluorin compound, the quantity by weight of the aluminum contained in the aluminum compound being greater than that of the fluorin contained in the fluorin compound, and the heating operation being stopped before the glass returns to a clear glass stage and before the specks are eliminated.

3. The herein described mixture for manufacturing illuminating glass, which consists in a foundation mixture capable of making substantially colorless clear glass, oxid of aluminum and a fluorid, in the following quantities by weight—150 parts of the foundation mixture, 9 to 15 parts of oxid of aluminum, and 3 to 8 parts of the fluorid.

Reissue No. 13,766. Method and Batch or Mixture for Making Illuminating Glass. Macbeth (Assigned to Macbeth Evans Glass Co.), July 7, 1914.

The invention relates to a method and batch or mixture for making glass for illuminating purposes such as in electric and other shades and globes. It has for its primary objects, the provision of a process and batch which will produce a snow white glass which is not clear but which is translucent to a high degree and will transmit light without the reddish or yellow color known as fire, the glass in these respects distinguishing from the well known opal glasses which are either substantially opaque (and known as milk glass) or are to some degree translucent, in which case the coloring above referred to as fire is always noticed when light is observed through the glass; the provision of a process and batch which will produce a glass which transmits light better than the opal glasses and which is subject to a minimum amount of breakage upon the application of heat, and the provision of a batch and process which will produce a glass having a white luminous appearance when transmitting light, with such light diffused in a pleasing manner restful to the eyes, and with a minimum loss of illuminating power.

In carrying out my invention, I first take a batch or mixture somewhat similar to a batch or mixture used in the manufacture of colorless clear glass, the preferred ingredients whereof will be hereinafter more particularly pointed out, and to such basic batch or mixture I add substances, one of which is preferably oxid of aluminum and the other a fluorid, preferably fluorspar, although some other fluorid might be used. The use of the oxid of aluminum with this fluorid apparently produces throughout the glass minute specks, the larger of which are ordinarily visible to the naked eye, and which have the effect of diffusing or scattering the light and giving the glass its white luminous

appearance. The specks in the finished ware are elongated in shape, and I believe them to be bubbles of silicon fluorid gas held in suspension in the material and elongated during pressing or blowing the glass into molds.

In manipulating the glass batch, the duration of operation and the degree of heat must be regulated so as not to entirely obliterate the so-called specks or bubbles, which obliteration appears to result when the heating is too intense or is carried on for too long a period. I therefore stop the heating operation at a time short of the production of complete transparency and the obliteration of the specks or bubbles from the glass, the glass tending to return to its colorless crystal stage if the operation is continued too long. In carrying out the operation I have found that good results are obtained in a furnace working at a temperature of approximately 2,700 degrees F., although this may be varied, and changes in temperature (as between 2,500 degrees and 3,000 degrees F.) may be compensated for, in a measure at least, by variations in the mixture or the length of time of the operation, which latter in many cases I have found to be less than twenty-four hours.

The specific combination of ingredients in the foundation or basic mixture or batch which I have found to give the best results is as follows:

Sand	100 lbs.
Lead oxid	15⅝ lbs.
Soda	21⅞ lbs.
Niter	5½ lbs.
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Borax	1¼ to 2½ lbs.

To the foregoing batch are added 18.12 pounds of hydrate of aluminum ($Al_2H_6O_6$) containing about 11.84 pounds of oxid of alumina (Al_2O_3) and six pounds of fluorspar (CaF_2). The materials are mixed together and fused as heretofore indicated.

The proportions of the oxid of alumina and the fluorid are not absolutely fixed, but may vary somewhat. The limit in the ratio of the fluorid to the oxid of alumina is reached when the resultant glass becomes an opal glass instead of a translucent glass without the fire characteristics of the opal glass. The relative proportions will also vary somewhat, depending upon the variations in the basis or foundation glass.

The glass produced by the present process is distinguished from other glasses containing fluorin, by the fact that the glass of the present process is translucent and yet without the characteristic known as fire of opal, whereas the fluorid glasses as heretofore produced were all properly definable as milk or opal glasses, being either white and opaque, or else partially opaque and showing with transmitted light a reddish or yellow color known to the trade as fire and bearing a resemblance to the color in natural opals.

What I claim is:

1. The herein described method of manufacturing illuminating glass, which consists in fusing together a foundation mixture capable of making substantially colorless clear glass with an aluminum oxid compound, and a fluorid, the quantity of the aluminum oxid compound by weight being greater than that of the fluorid, and the amount of aluminum by weight contained in the aluminum oxid compound being greater than that of the fluorin contained in the fluorid, and the heating operation being stopped before the glass returns to a clear glass stage and before the specks are eliminated.

2. The herein described method of manufacturing illuminating glass, which consists in fusing together a foundation mixture capable of making substantially colorless clear glass and including a chlorid, with an aluminum compound and a fluorin compound, the quantity by weight of the aluminum contained in the aluminum compound being greater than that of the

fluorin contained in the fluorin compound, and the heating operation being stopped before the glass returns to a clear glass stage and before the specks are eliminated.

3. The herein described mixture for manufacturing illuminating glass, which consists in a foundation mixture capable of making substantially colorless clear glass, oxid of aluminum and a fluorid, in the following quantities by weight—150 parts of the foundation mixture, 9 to 15 parts of oxid of aluminum, and 3 to 8 parts of the fluorid.

4. The herein described mixture for manufacturing illuminating glass, which consists in a batch containing 150 parts by weight of the foundation mixture capable of making substantially colorless clear glass, a compound containing aluminum and a compound containing fluorin, the quantity of the aluminum in the batch by weight being from 4 to 8 parts, and the quantity of fluorin in the batch by weight ranging from 2 to 4 parts.

5. The herein described mixture for manufacturing illuminating glass, which consists in a foundation mixture capable of making substantially colorless clear glass and including a chlorid, an aluminum compound, and a fluorin compound, the amount of aluminum by weight contained in the aluminum compound being greater than that of the fluorin contained in the fluorin compound, and the weight of the aluminum and fluorin combined being at least 1% of that of the entire mixture.

6. The herein described mixture for manufacturing illuminating glass, which consists in a foundation mixture capable of making substantially colorless clear glass, an aluminum compound and a fluorin compound, the amount of fluorin by weight contained in the fluorin compound being less than 61% of that of the aluminum contained in the aluminum compound, and the weight of aluminum and fluorin compound

combined being at least 1% of that of the entire mixture.

7. The herein described mixture for manufacturing illuminating glass, which consists in a foundation mixture capable of making substantially colorless clear glass, an aluminum compound and a fluorin compound, the amount of aluminum by weight contained in the aluminum compound being greater than that of the fluorin contained in the fluorin compound, and the weight of the aluminum and fluorin combined being at least 1% of the entire mixture.

No. 1,122,065. Artificial-Lighting Means. Brady (Assigned to United Gas Improvement Co.), Dec. 22, 1914.

The invention relates to color filters or absorbing screens which operate to modify artificial light passing through them so as to produce a resultant illumination equivalent to daylight.

The principal object of the present invention is to provide an efficient color filter or absorbing screen which may be constructed wholly of glass and which may therefore assume various forms useful in the arts, such as bulbs for incandescent electric lights and shades of various kinds.

An absorbing screen or color filter in order to alter an artificial light spectrum to that of daylight must absorb excessive radiations. If the relative intensities of the different colors of the spectrum are plotted upon such a scale that the intensities of daylight and the artificial light sources are the same at the blue extremity of the spectrum, then the transmission of the absorbing screen must be as the reciprocal of the ratio at each color of the intensity of the artificial light spectrum to the daylight spectrum.

The color filter or absorbing screen is adapted by absorption to produce the above described, or perhaps more accurately a very close approximation to it.

In the present invention the color filter or absorbing screen is of signal green and purple color, with or

without a blue color. There is nothing new about the signal green and purple color, but the point of the present invention is that the color filter or screen may consist of glass containing or embodying these colors and since it is of glass, is otherwise proper and effective for the purpose in hand, it can be used, for example, as the globe or bulb of an electric light and in that case there is provided a source of artificial illumination which has the effect of daylight, and such a source of artificial daylight illumination is so far as I know at present unknown.

I am, of course, aware of the fact that color screens or filters have been made or suggested but I do not believe that there ever existed a source of light such as an electric lamp in which the globe or bulb operated to make the electric lamp produce immediately and directly the effect of daylight illumination.

To produce glass of the requisite purple color, use is made of nickel which may be introduced as nickel oxid or salts and the use of this material for the purpose of making artificial daylight glass, I believe to be novel. It is well known that signal green glass can be produced by the use of copper and blue glass can be produced by the use of cobalt.

By way of further description, and not limitation, it may be said that where potash lime glass is used the following proportions produce good results:

Sand	.208	pounds.
Potassium carbonate	.091	"
Calcium carbonate	.025	"
Potassium nitrate	.0167	"

To a batch weighing one-third of a pound or 2,333 grains, four grains of black nickel oxid, Ni_2O_3, may be added to produce the required kind of purple glass. To a similar batch 15 grains of black copper oxid may be added to produce the signal green glass of required color. When this is done the glasses would be sepa-

rate and could be intimately mixed. Instead of doing this the nickel oxid and the copper oxid in the quantity stated may be added to the batch of glass and in that case the result is the same and there is but one layer of glass. Oxid of cobalt may be added to a proper batch of glass, making material to produce blue glass, or the oxid of cobalt may be added along with the oxid of nickel and oxid of copper.

In giving proportions of the coloring materials it must be borne in mind that the proportions are not hard and fast, but are to be changed so as to produce the desired result from any artificial light under consideration, having regard to the thickness of the glass. This is well understood by those skilled in the art.

What I claim is:

1. A color filter or absorbing screen for transforming the light of artificial illuminants to daylight character comprising a glass composition containing nickel, copper and cobalt and being of generally blue color when viewed by daylight.

2. A color filter or absorbing screen for transforming the light of artificial illuminants to daylight character comprising a potash glass composition containing nickel, copper and cobalt and being of generally blue color when viewed by daylight.

No. 1,122,066. Artificial Lighting Means. Brady. (Assigned to United Gas Improvement Co.). Dec. 22, 1914.

The invention relates to color filters or absorbing screens which operate to modify artificial light passing through them so as to produce a resultant illumination equivalent to daylight.

The principal object of the present invention is to provide an efficient color filter or absorbing screen which may be constructed wholly of glass and which may therefore assume various forms useful in the

arts, such as bulbs for incandescent electric lights and shades of various kinds.

An absorbing screen or color filter in order to alter an artificial light spectrum to that of daylight must absorb these radiations. If the relative intensities of the different colors of the spectrum are plotted upon such a scale that the intensities of daylight and the artificial light sources are the same at the blue extremity of the spectrum, then the transmission of the absorbing screen must be as the reciprocal of the ratio at each color of the intensity of the artificial light spectrum to the daylight spectrum.

The color filter or absorbing screen is adapted by absorption to produce the above described result, or perhaps more accurately, a very close approximation to it.

In the present invention the color filter or absorbing screen is of purple color and blue color. The point of the present invention is that the color filter or screen may consist of glass, containing or embodying these colors and since it is of glass and is otherwise proper and effective for the purpose in hand, it can be used, for example, as the globe or bulb of an electric light and in that case there is provided a source of artificial illumination which has the effect of daylight and such a source of artificial daylight illumination is so far as I know at present unknown.

I am, of course, aware of the fact that color screens or filters have been made or suggested, but I do not believe that there ever existed a source of light such as an electric lamp in which the globe or bulb operated to make the electric lamp produce immediately and directly the effect of daylight illumination.

To produce glass of the requisite generally blue color and absorbing qualities, use is made of nickel which may be introduced as nickel oxid or salts, and the use of this material for the purpose of making artificial daylight glass I believe to be novel. It is well

known that blue glass can be produced by the use of cobalt.

By way of further description, and not limitation, it may be said that where potash lime glass is used the following proportions produce good results:

Sand	.208 pounds.
Potassium carbonate	.091 "
Calcium carbonate	.025 "
Potassium nitrate	.0167 "

To a batch weighing one-third of a pound or 2,333 grains, four grains of black nickel oxid, Ni_2O_3, may be added to produce the required kind of purple glass. To a similar batch cobalt oxid may be added to produce the blue glass of required color. When this is done the glasses can be mixed together. Instead of doing this, the nickel oxid and the cobalt oxid may be added to the batch of glass.

In giving proportions of the coloring materials it must be borne in mind that the proportions are not hard and fast, but are to be changed so as to produce the desired result from any artificial light under consideration, having regard to the thickness of the glass. This is well understood by those skilled in the art.

I claim:

1. A color filter or absorbing screen for transforming the light of artificial illuminants to daylight character comprising a glass composition containing nickel and cobalt and being of generally blue color when viewed by daylight.

2. A color filter or absorbing screen for transforming the light of artificial illuminants to daylight character comprising a potash glass composition containing nickel and cobalt and being of generally blue color when viewed by daylight.

No. 1,130,767. Composition for Making Glass. Schott. (Assigned to Schott and Gen.), Mar 9, 1915.

By the invention a kind of glass is realized, which considerably surpasses in its capacity of resisting chemical action the well known kinds of glass of about the same cost of production and of the same general applicability. In consequence of this property the new kind of glass is particularly suitable for chemical apparatus and for gage-glasses.

In the kind of glass according to the present invention at least 50 per cent of silicic acid is made use of as in well known kinds of glass. Besides the said silicic acid the new glass further contains alumina 4 to 15 per cent, lime 3 to 11 per cent, boracic acid 5 to 15 per cent, and alkali 4 to 14 per cent. The percentage of alumina and lime together however must amount to not less than half and not more than five times the percentage of the boracic acid. While no other glass-forming components are employed for the new kind of glass, of course the addition of a small quantity of one or more other substances having some such secondary purpose as a coloring of the glass is not excluded.

Soda is suitable as the alkaline component. According to the experience gained, when working out the invention, the new kind of glass displays a particularly great capacity of resisting chemical action, when in the choice of the amount of soda and of the amount of alumina these amounts are kept well within the limits given above, *i. e.,* when with a proportion of soda of 8 to 12 per cent not less than about 6, but also not more than about 12 per cent of alumina are taken.

I claim:

1. Glass containing at least 50 per cent silicic acid and having as its other glass forming components alumina 4 to 15 per cent, lime 3 to 11 per cent, boracic acid 5 to 15 per cent and alkali 4 to 14 per cent, the

total percentage of alumina and lime being at least half and at most five times that of the boracic acid.

2. Glass containing at least 50 per cent silicic acid and having as its other glass forming components alumina 6 to 12 per cent, lime 3 to 11 per cent, boracic acid 5 to 15 per cent and soda 8 to 12 per cent, the total percentage of alumina and lime being at least half and at most five times that of the boracic acid.

No. 1,136,504. Glass and Art of Making the Same. Brookfield, Apr. 20, 1915.

The object of the present invention is to obtain a vitreous product of tough, hard and durable quality which can be worked like plastic glass into various shapes such as insulators. The product obtained from this process may be suitably called a glass compound since it takes on the character of glass to a large degree and consists in a mixture of glass material with an ingredient for giving toughness and hardness thereto. This toughening ingredient which may be one of the common clays used in porcelain making, is added to the glass in suitable proportions so as not to destroy the vitreous character of the product but on the contrary to remain sufficiently plastic after fusion to be molded and pressed in the various shapes desired.

In carrying out my process I first pulverize a quantity of previously formed glass or cullet and thoroughly mix with the same a suitable percentage of pulverized clay or its equivalent. The cullet may be obtained from ordinary scrap glass containing portions of lime or lead glass, but if manufactured particularly for this process, the lime glass is preferred on account of its cheapness. The clays suitable for my purpose may be either the primary clays such as kaolin, or the secondary clays commonly known as pipe or ball clay, although the more infusible clays such as the fire clays containing large quantities of free silica, quartz, etc, are less preferred. The two

ingredients of my mixture, namely, the cullet and the clay, may be ground to a powder either separately and afterward mixed, although I prefer to grind them together to obtain a more thorough and intimate mixture. This mixture is then heated to approximately 2,500° Fahrenheit for fusing the same and rendering the mass sufficiently plastic so as to be workable into glass articles. The proportion of clay in the mixture may be varied widely, but is preferably kept small enough so that the mixture will not be absolutely infusible at the temperature stated. On the other hand this proportion of clay may be large enough to cause the mass to only partially fuse into a semi-plastic, semi-liquid condition which is workable into articles. I have found that suitable proportions for the original mixture are 30 pounds of clay or equivalent, to every 100 pounds of cullet. If too large a percentage of clay is added to the mixture, the mass upon heating, will not be sufficiently fused to become homogeneous, since portions of the clay collect in irregular unfused lumps throughout the mass. If desired, pulverized lime CaO may also be added together with the clay to the cullet, as an ingredient of the original mixture, since it increases the fusibility of the clay, and also possesses the same quality as clay in rendering the resulting product tough and durable.

It will thus be seen that by the present process a vitreous product of amorphous character is produced, having all of the advantageous characteristics of glass in being plastic and workable, and yet tougher and more durable than ordinary glass products.

What I claim is:

1. The process of making a glass compound, which is non-crystalline in character, which consists in thoroughly mixing pulverized glass or cullet with pulverized clay, the proportion of glass being comparatively large, subjecting the same to an approximate heat of 2,500° F., cooling and annealing the same.

2 The process of making a glass compound, which is non-crystalline in character, which consists in thoroughly mixing pulverized glass or cullet with pulverized clay and lime, the proportion of glass being comparatively large, subjecting the same to approximate heat of 2,500° F., cooling and annealing the same.

1,143,732. Glass. Schott (Assigned to Schott & Gen.), June 22, 1915.

Further investigations regarding the glass protected by Patent No. 1,130,767 have shown, that a glass capable of withstanding chemical influences may also be obtained, if the lime be wholly or in part replaced by magnesia, zinc oxid or baryta, the proportions being so chosen that the place of a part by weight of lime is always taken by an equivalent quantity of one of the said substitute substances or of several of them. While no other glass-forming components are employed for the new kind of glass, of course the addition of a small quantity of one or more other substances having some such secondary purpose as a coloring of the glass is not excluded.

The following table contains six examples. Example I gives the composition of a kind of glass according to the above patent, while examples II to VI give the composition of new kinds of glass. All the examples contain the same percentages respectively of alkali, boracic acid and alumina; the 3% of lime of example I are replaced in example II by the equivalent quantity of magnesia (2.2%), in example III by the equivalent quantity of zinc oxid (4.3%), and in example IV by the equivalent quantity of baryta (8.2%). In example V 2% of lime are retained, while 1% of lime is replaced by the equivalent quantity of magnesia (0.7%), and in example VI the proportion of lime of example I is replaced by

magnesia and zinc oxide (1.1% and 2.1%). The proportion of silicic acid in examples II to VI is partly greater and partly less than in example I.

	I.	II.	III.	IV.	V.	VI.
Alkali	13	13	13	13	13	13
Boracic acid	10	10	10	10	10	10
Lime	3	...	...	...	2	...
Magnesia	...	2.2	...	...	0.7	1.1
Zinc oxid	...	...	4.3	...	...	2.1
Baryta	...	...	...	8.2	...	...
Alumina	12	12	12	12	12	12
Silicic acid	62	62.8	60.7	56.8	62.3	61.8

Claim:

Glass containing at least 50 per cent silicic acid and having as its other glass forming components, alumina, 4 to 15 per cent; boracic acid, 5 to 15 per cent; alkali, 4 to 14 per cent; magnesia, at most, 7.8 per cent; zinc oxid, at most, 15.9 per cent; baryta, at most, 30 per cent; and lime, the total percentage of lime, magnesia, zinc oxid and baryta being a quantity representing the equivalent of from 3 to 11 per cent of lime, the total percentage of alumina, lime and that quantity of lime, which would represent the equivalent of the percentages of magnesia, zinc oxid and baryta being at least half and at most five times that of the boracic acid and the total percentage of magnesia, zinc oxid and baryta being greater than zero.

No. 1,143,788. Glass and Batch for Making the Same. Schnelbach (Assigned to Macbeth-Evans Glass Co.), June 22, 1915.

My invention relates to a new and useful composition for the manufacture of translucent and opaque glass.

My invention consists in the composition hereinafter specified for the manufacture of translucent and opaque glass.

In the manufacture of my new and improved glass, I use the following mixture or batch of ingredients, substantially in the proportions by weight hereinafter indicated, to wit: sand, 345.8 pounds; litharge, 56.8 pounds; soda ash (carbonate of soda), 86.4 pounds; cryolite, 20 pounds; aluminum oxid, 60 pounds; niter, 32 pounds; borax, 8 pounds; plaster of Paris (calcium sulfate, $CaSO_4$), 5 pounds.

These ingredients, in substantially these proportions, thoroughly ground, pulverized and mixed, are placed in the ordinary glass pot in a glass-house furnace and heated until entirely fused, with the result that they produce a glass that is translucent, opaque and free from specks; a glass which, when pressed into proper shapes for use with electric or gas light, has more than ordinary powers for reflecting and diffusing, and at the same time absorbing but very little of the light with which it is used.

I have discovered that three of the above ingredients, to wit, cryolite, aluminum oxid and plaster of Paris, when used together in substantially the proportions herein set forth, have the effect of clouding or rendering translucent and at the same time opaque, the ordinary crystal glass which would result from the mixing of the other ingredients of the batch or mix hereinbefore specified. The result of the use of the three ingredients, cryolite, oxid of alumina, and plaster of Paris, as affecting the translucency, the opacity, and the diffusive and deflective powers of the glass manufactured from the ingredients herein specified, is similar with any batch that will produce the ordinary crystal glass, whether made with a lead or a lime base, provided additional ingredients equivalent to niter and borax are used therewith.

The batch set forth totals 614 pounds. The aluminum in the batch is contained in the aluminum oxid (AI_2O_3) and in the cryolite (Na_3ALF_6), the percentage of aluminum in these two compounds being

respectively 52.9% and 12.9%, so that in the 60 pounds of aluminum oxid there are 31.74 pounds of aluminum, and in the cryolite there are 2.58 pounds of aluminum, a total of 34.32 pounds or 5.59% of the entire batch. The fluorin in the batch is contained in the cryolite which is 54.3% fluorin so that in the 20 pounds of cryolite there are 10.86 pounds of fluorin or 1.77% of the entire batch. The plaster of Paris ($CaSO_4$) comprises 5 pounds or .81% of the entire batch, the amount of sulfur in the plaster of Paris being 23.6% thereof or .19% of the total batch.

As the aluminum, fluorin and sulfur are the coloring or opacifying agents, other compounds containing them might be substituted, provided an adjustment be made to secure the proper amounts of said elements as heretofore set forth. The amount of the opacifying agents may also be varied depending upon the opacity desired.

I claim:

1. A batch for producing glass consisting of a foundation mixture capable when fused of producing a substantially colorless glass, so combined with a sulfate and aluminum and fluorin compounds that the resulting glass will contain undecomposed sulfate.

2. A batch for producing glass consisting of a foundation mixture capable when fused of producing a substantially colorless glass, combined with a sulfate and with aluminum and fluorin compounds and free from any material tending to decompose the sulfate at the working temperature of a glass furnace.

1,143,885. Process for Making A Compound of Glass. Brookfield, June 22, 1915.

This invention relates to a process for making a compound of glass much tougher and harder in quality than ordinary glass now known, and which glass compound is particularly suitable for use as insulators and other glass articles requiring a tough, nonfragile and durable quality.

In general the compound formed by this process is characterized by a large percentage of an oxid of one of the alkaline earths. It is well-known among glass manufacturers that the presence of calcium oxid (CaO) or lime imparts a tough quality to glass, but heretofore it has been impossible to increase the percentage of lime in the glass to any great extent. If too large a proportion of lime is added as one of the original ingredients of the batch which is to be formed into the glass, it will render the batch infusible at the temperatures ordinarily employed, or if the batch is partially fused it is found that the lime collects in irregular, unfused lumps throughout the mass, destroying its homogeneity and resulting in an almost worthless product. Although among glass manufacturers the recipes for the batch are mostly empirical, it is believed that at present not more than ten to fifteen per cent of the batch is lime, either in the form of pure calcium oxid or in the form of a salt which breaks up into the oxid during fusion, and it is believed that any larger percentage of lime in the batch than that above indicated would result in the worthless product above described.

My process contemplates the progressive addition of the oxid to the other elements of which the glass is composed.

Describing my process and the compound obtained thereby more particularly, I first obtain a finely pulverized cullet which may be scrap glass of different descriptions and probably containing proportions of both lime and lead glass, or I may manufacture glass in the ordinary way and grind it into pulverized form. Of course if the cullet is manufactured, it will be preferable to obtain it by the lime glass process on account of the cheapness of the lime. Into the pulverized cullet, presumably already containing as one

of its constituents as much lime as ordinary glass may possess, I mix thoroughly by any suitable mechanical means a pulverized oxid of one of the alkaline earths, for instance, calcium oxid (CaO) or lime. In place of pure lime I may, of course, add any of the usual salts or hydrates of the alkaline earths, provided they are capable of furnishing the oxid when fused in the mixed mass. For example, I may employ in the mixture ordinary powdered marble or chalk, calcium carbonate ($CaCo_3$), in place of lime, since this compound during the subsequent fusion of the mass apparently breaks down into the oxid (CaO) with consequent escape of carbonic acid gas (Co_2). The escape of gas from the fused mass, however, causes bubbles which may in some cases destroy the homogeneity of the resulting product. Consequently the use of the oxid of the calcium or other alkaline earth is preferred over the salts and hydrates.

The cullet and the lime or its equivalent above described may be ground separately into their pulverized form and afterward mixed if desired, but I find it preferable to grind these ingredients together since a more intimate, uniform and thorough mixture is thus obtained.

The mixture is then heated to approximately 2,500° F. for fusing or partially melting the same into a homogeneous mass having the lime evenly distributed and thoroughly incorporated in the same. The proportion of lime in this heated mixture is preferably high enough to result in a semi-plastic, semi-liquid mass at the temperature stated, which is workable into shape for various glass articles. The material upon cooling may be either amorphous or devitrified, but at any rate, it is found to be of uniform character throughout and a much tougher and harder product than ordinary glass.

The exact proportions of lime or its equivalent added to the mixture may vary within wide limits since any addition of lime whatever to the glass cullet results in a tougher product than ordinary glass and the maximum limit is only that amount which will allow the heated mixture to sufficiently fuse together into a homogeneous mass workable into shapes, but obviously no silica is added to the ground cullet. I have found that suitable proportions for the mixture may be thirty pounds (30 lbs.) of lime or its equivalent, to every one hundred pounds (100 lbs.) of cullet.

If, during fusion, bubbles of gas escape, due to the presence of impurities or to the employment of salts in the mixture as before stated, the mass should not be allowed to cool until this bubbling ceases and the mass is quiescent. As this often requires a longer heating of the mass, and consequent greater expense, a further reason is seen for preferring the oxids in the original mixture over the carbonates or other salts. For the same reasons of economy the calcium compounds are preferred over those of the other more expensive alkaline earths such as barium, strontium, etc.

The term fusion is used herein to indicate that blending or coalescence of the mixed materials, through melting or partial melting, into a homogeneous mass.

The difficulty of obtaining a uniformly fused mass has heretofore prevented the introduction of a larger percentage of the lime into the batch mixture in making glass, but in the present method of adding lime to the already obtained glass, we are able to manufacture a glass compound having all qualities due to a larger percentage of lime, and yet of homogeneous structure.

What I claim is:

1. The process of making a glass compound containing an excess of one ingredient, which comprises the steps of mixing with ground glass, containing the usual amount of said ingredient, a chemical compound of said ingredient such as will furnish the oxid thereof, and fusing the whole to incorporate this excess into the mass.

1,151,911. Glass. Sullivan & Taylor (Assigned to Corning Glass Works), Aug. 31, 1915.

This glass is intended for making union with metallic parts, as in electric incandescent lamps. It has a coefficient of expansion varying between .000012 and .000017.

A glass which is soft and relatively stable, possesses good vitrification, and remains viscid or pasty through a relatively wide temperature is made of the following composition:

SiO_2	42%
Na_2O	19%
K_2O	5%
BaO	19%
Al_2O_3	15%

Such a glass has a coefficient of expansion of .0000135 and a hardness of 630°C.

We claim:

1. A glass for the purpose stated having a linear expansion of more than .000012 and a hardness of less than 640° and containing barium oxid and alumina.

No. 1,153,353. Batch for Semi-Opaque, Semi-Translucent Glass. Stiefel (Assigned one-half to A. M. Neeper), Sept. 14, 1915.

My invention relates to new and useful improvements in semi-opaque, semi-translucent white glass.

One of the principal objects of my invention is to produce semi-opaque, semi-translucent glass of whitish color, without fluorescence or fire and without the use of fluorin or a compound thereof.

My invention consists of a semi-opaque, semi-translucent whitish glass made without the use of fluorin or a compound thereof and the batch therefor.

The batch for my improved glass consists of the ingredients commonly used for the production of crystal glass in connection with the use of nitrate of lime as one of the ingredients thereof, preferably consisting of sand, soda ash, lead oxide, nitrate of lime and suitable decolorizing agents; of an opacifying agent which does not contain fluorin and is not a compound thereof; and certain ingredients which are consistent with the above two classes of ingredients, which when heated in connection therewith are comparatively inert but are productive of a gas when fused therewith which keeps the entire mass of the batch in gentle ebullition.

Preferably the batch will consist of the following ingredients in substantially the following quantities by weight: sand, 60 parts; soda ash, 15 parts; lead oxid, 15 parts; nitrate of lime, 3-1/2 parts; phosphate of magnesia, 3-1/2 parts or less; carbonate of magnesia, 3-1/2 parts; alum, 3-1/2 parts. Using 3-1/2 parts of phosphate of magnesia makes a comparatively opaque whitish translucent glass. If it is desired that the glass made have a greater degree of translucency, then the quantity of phosphate of magnesia may be reduced until the desired degree of translucency is attained; by adding a greater quantity than 3-1/2 parts, by weight, to the batch the glass will become a white opaque glass. The phosphate of magnesia is introduced as a fine, white, dry powder.

The batch substantially in the quantities above indicated being introduced into the melting pot of a glass furnace has heat applied to it until the fusible

ingredients of the batch are completely fused and volatile products escape. The application of heat to the batch has the effect of dislodging from the carbonate of magnesia carbonic acid gas; from the alum the gases composing the water contained in that compound, as well as the gases in the phosphate of magnesia. The escape of these gases during the fusion and heating of the mass keeps the batch in a gentle constant state of ebullition and causes the phosphate of magnesia, which by the heat applied is transformed into fine particles of pyrophosphate of magnesia, to be distributed as fine solid particles through the fused mass, thereby imparting to the mass and the resultant glass made therefrom opacity and translucency. The absence of the fluorin or a compound thereof results in the glass, manufactured according to my invention, being entirely free from fluorescence or "fire" usually present in opal glasses.

What I claim as my invention is:

1. A batch for a semi-opaque, semi-translucent glass, consisting of a foundation batch to produce a crystal glass, in combination with phosphate of magnesia, and additional ingredients comparatively inert and neutral to the foregoing ingredients of said batch, which upon the fusion thereof evolve gases which in passing off keep said batch, while in a fused condition, in a condition of ebullition.

2. A batch for a semi-opaque, semi-translucent glass, consisting of a foundation batch to produce crystal glass, one of whose ingredients is nitrate of lime, in combination with phosphate of magnesia and additional ingredients comparatively inert and neutral to the foregoing ingredients of said batch, which, upon the fusion thereof evolve gases which in passing off keep said batch, while in a fused condition, in a condition of ebullition.

No. 1,158,922. Glaze, Enamel or Glass Composition. Hull, Nov. 2, 1915.

My discovery and invention relates to glazing, enameling or glass manufacture, and has for its object the provision of the desired metallic constituent in glaze, enamel or glass in an effective, economical and safe manner.

My discovery and invention consists in providing the metal constituent in its uncombined form.

My discovery and invention is more particularly applicable to glazing of pottery ware, tile and earthenware, in which a salt or other product of corrosion of or chemical action upon metal is used.

Glazes, enamels and glass have long been made with the addition of some salt of a metal or other product of corrosion of or chemical action upon the metal, such as oxid of lead, carbonate of lead or white lead, or oxid of zinc, the function of these ingredients generally being to impart to the glaze, enamel or glass composition increased fusibility, or to impart to the finished product thereof increased strength, density, softness or luster. I have discovered that the metal itself may be incorporated in the glaze, enamel or glass, and that the metal itself will produce the effect which the carbonate or oxid or other product of corrosion of or chemical action upon the metal will produce. While the metal constituent thus provided in its metallic form is a suitable substitute for the substances heretofore used, it affords a considerable saving, because the metal generally costs no more for a given weight than does the metal in combined form, since, as it seems, the metal, aside from the other elements combined with it in the combined form, is the active element; and the other elements are either driven off during the firing or heating or combined in the glaze without having any utility. Thus, taking carbonate of lead or white lead as an example, which is largely used as a constituent of glaze, enamel or glass, it seems that the carbon and oxygen combined

with the lead has no utility and performs no function in the glaze; but as is well known in the art, carbonate of lead or white lead costs substantially the same as the metallic lead, and commands substantially the same or a slightly higher price on the market; so that the potter or manufacturer in buying this ingredient, is obliged to pay for a certain weight of carbon and oxygen, or other extra substance, in the carbonate of lead, in order to obtain the effect of the amount of lead element in the ingredient, whereas, by using the lead in its metallic form, practically no other substance is bought, and practically all of the ingredient is useful in the glaze. Experience in connection with my discovery and invention has shown that this circumstance admits of the reduction of weight of this constituent from 25 to 50 per cent, and the results attained are fully equal to those that have been obtained with the use of the white lead or other combined form of or product of corrosion of or chemical action upon the particular metal desired to be used in the glaze, enamel or glass.

Where carbonates or oxids or other combined forms of products of corrosion of or chemical action upon the materials have been used, they have been obtained in finely pulverized condition so that they are readily suspended in the liquid mixture of the glaze, and thus uniformly distributed throughout the glaze on the ware as the ware is dipped into the glazing mixture, or as the mixture is applied to the ware with a brush or otherwise. In utilizing the metal itself I provide it in finely pulverized form, preferably in a substantially impalpable powder, and find that it is capable of suspension in the mixture substantially as uniformly as the ingredient in combined form would be; and that, when the proper proportion of the metal is used, the finished product will be found uniform in appearance and without any appearance of the metal. In providing the finely pulverized metal, especially with respect to lead, it is preferably obtained

as a result of a process of comminuting or granulating lead to be corroded in the manufacture of carbonate of lead or white lead. The greater proportion of white lead is used in the making of paint and similar products, while a less but important proportion has been used for the metallic constituent of glazes, enamels or glass. For the purposes of corrosion, the lead need not be so finely divided, and a comminuting process which has been found thoroughly practicable for corroding purposes consists in the ejection of molten lead in a small jet into a chamber where it is suddenly condensed and falls in the form of a rather fine powder or small granules. At the same time this moderately fine powder is produced there is a much finer powder of the lead, which is deposited along with the coarser particles; and by introducing a fine screen, which allows the fine powder to pass through but retains the coarser powder or granules.

I claim:

1. A glaze, enamel or glass composition containing as an ingredient a metal in its metallic state and in the form of a substantially impalpable powder produced by condensation of the metal in a finely divided form.

No. 1,166,922. Method and Batch or Mixture For Making Illuminating Glass. Meara (Assigned to Gill & Co.), Jan. 4, 1916.

In the manufacture of glass for illuminating purposes, such as electric and other similar shades and globes, it is desirable to employ a process and batch which will produce a glass having a snow white appearance and which will be translucent to a high degree, and will, at the same time, be not clear, and adapted to transmit light without the yellow or reddish color, known as fire, the glass in these respects distinguishing from the well-known opal glasses, which are either substantially opaque and known as milk glass or are to some degree translucent, in which case the coloring known in this art as fire is always noticeable when light is observed through the glass

My invention further consists of a novel process and batch, which will produce a glass having a white luminous appearance when transmitting light, with such light diffused in a manner pleasing and restful to the eyes, the glass being subject to a minimum amount of breakage upon the application of heat, as well as a minimum loss of illuminating power, while the so-called specks or bubbles heretofore existing in glass of this general character, wherein a fluorin compound or fluorid is employed, are substantially obliterated or eliminated in my process and batch.

In carrying out my invention, I first take a batch or mixture, the preferred ingredients being hereinafter particularly pointed out, and fuse the same to a preferred temperature, the result of my novel process and the manipulation of the glass batch resulting in a product wherein the so-called specks or bubbles are practically obliterated or eliminated. If desired, I may stop the heating operation of the batch at such a period as will be short of the production of complete transparency and the obliteration of the specks or bubbles from the glass, the glass tending to return to its colorless crystal stage, if the operation is continued too long, but I prefer to continue the fusing or heating operation until the obliteration of said specks is nearly completed.

In practice, I have found that good results are obtained in a furnace working at a temperature of approximately between 2,500 and 3,000 degrees F. and the length of time of the operation generally required is from twenty-one to twenty-four hours.

The ingredients from which the batch or mixture is composed are the following, combined in substantially the proportions stated: Sand, 100 lbs.; alumina, 30 lbs.; oxide of lead, 22 lbs.; silex, 12 lbs.; soda, 37 lbs.; borax, 6 lbs.; oxid of arsenic, 3 lbs.; oxid of antimony, 1 1/4 lbs.; common salt, 1 1/2 lbs.; salt cake (crude sodium sulfate), 1 1/2 lbs.; crystallized Glauber salts, 2 lbs.; gypsum, 1 1/2 lbs. Said in-

gredients are fused in any suitable manner and form, when so combined, a white translucent glass which transmits, when formed into a sheet, globe or shade, light of a white color and free from yellow, red or opalescent rays.

The proportions of the ingredients of the mixture may be changed, if desired or required, according to the use of the glass and its purposes, but for the manufacture of globes or shades for lamps, substantially the above formula of proportions has been proved to be most satisfactory.

I desire to call special attention that in my novel foregoing process and batch, I entirely dispense with the use of a fluorid or a fluorin compound, as has been heretofore employed, and preferably employ the foregoing ingredients, whose relative proportions may vary somewhat, depending upon the variation in the basic or foundation glass. I preferably manipulate the glass batch composed of the foregoing ingredients, so that the duration of operation and the degree of heat may be regulated so as to substantially obliterate or eliminate the so-called specks or bubbles, but I do not desire to be limited to any exact duration of operation or to any exact degree of heat as this may be modified or compensated for by variations in the mixture or the length of time of the operation, as will be apparent to those skilled in this art.

I am aware of the reissued patent to Macbeth, No. 13,766, granted July 7th, 1914, and my present invention is clearly differentiated therefrom, since I employ no fluorid or fluorin compound, and no ingredient the equivalent thereof, as is evident.

It will now be apparent that I have devised a novel and useful method and batch or mixture for making illuminating glass, which embodies the features of advantage enumerated as desirable in the statement of the invention and the above description, and while I have, in the present instance, described a preferred

embodiment thereof which will give in practice satisfactory and reliable results, it is to be understood that the same is susceptible of modification in various particulars without departing from the spirit or scope of the invention or sacrificing any of its advantages.

I claim:

1. The herein-described method of manufacturing illuminating glass, which consists in fusing together a foundation mixture capable of making substantially colorless clear glass, said mixture comprising sand, alumina, oxid of lead, silex, soda, borax, oxid of arsenic, oxide of antimony, common salt, salt cake, crystallized Glauber salts and gypsum, and the heating operation being stopped at such a period that the specks in the glass are substantially eliminated.

2. The herein-described method of manufacturing illuminating glass, which consists in fusing together a foundation mixture capable of making substantially colorless clear glass, said mixture comprising sand, alumina, oxid of lead, silex, soda, borax, oxid of arsenic, oxid of antimony, common salt, salt cake, crystallized Glauber salts and gypsum, and the heating operation being stopped before the glass returns to a clear glass stage and at such a period that the specks in the glass are substantially eliminated.

3. The herein-described mixture for manufacturing illuminating glass, composed of sand, alumina, oxid of lead, silex, soda, borax, oxid of arsenic, oxid of antimony, common salt, salt cake, crystallized Glauber salts and gypsum, fused together.

No. 1,191,630. Composition of Glass. Weintraub (Assigned to General Electric Company), July 18, 1916.

The present invention relates to envelops of quartz and in particular to an improved seal between quartz and a metallic conductor.

Patent No. 910,969 describes a seal for quartz containers in which a metallic conductor is sealed into a

glass, the composition of which merges gradually into quartz with a progressively decreasing proportion of basic constituents of the glass.

I have found when experimenting with a large number of glasses that a sodium-magnesium boro-silicate which can be obtained in the market as "low expansion glass," has the property of forming fusions with silica in any proportion with the formation of exceptionally strong tough glass for all proportions. The glasses thus produced are amorphous masses devoid of crystallization and have all the desirable properties which are characteristic of what is termed a "glass."

My invention comprises new glasses of high melting point and low coefficient of expansion and richer in silica than any glasses produced so far, that is, in excess of about 73% silica. In view of the fact that these glasses are tough, and free from crystallization they could be used for any purposes where the above enumerated properties are desirable.

According to one method of carrying out my invention, low expansion glass is intimately mixed with progressively larger quantities of silica to make a series of melts. A boro-silicate suitable for this purpose has the following composition: Silica, SiO_2, 72 to 73 per cent; magnesium oxid, MgO, 3 to 4 per cent; boric anhydrid, B_2O_3, 11 to 12 per cent; sodium oxid, Na_2O, 12 to 13 per cent. It will be understood, of course, that this composition is illustrative. Potassium might be substituted for sodium.

A glass of the above composition or its equivalent, is very finely powdered and to separate portions ground quartz is added to the extent of about 15, 30, 50, 70 and 85% of quartz to 85, 70, 50, 30 and 15% respectively of glass. The proportions need not be strictly adhered to but are given for the purpose of illustration. These mixtures are fused to form glasses having an excess of 73% silica, as progressively larger portions of quartz are incorporated in the several por-

tions of low expansion glass. These glassy mixtures have a coefficient of expansion intermediate between 3.5×10^{-6}, which corresponds to low expansion glass, and about $.6 \times 10^{-6}$, which corresponds to quartz. Said glasses are built up at the end of the quartz tube by means of the oxygen blowpipe or arc so as to secure a progressive change of composition from silica to low expansion glass. For example, to the end of a quartz tube a ring or layer of the vitreous mixture comprising 85% of quartz and 15% of glass is applied and heated so as to unite and intermingle it with the quartz tube. This heating causes a further blending of the two materials so that the composition changes by almost imperceptible stages from pure quartz to the material containing an appreciable amount of admixture. This process is then repeated with a vitreous material containing a lower amount of admixed silica. By working in this way the basic constituents of the boro-silicate are progressively increased when receding from the region of pure silica until finally the tube is closed with a portion of low expansion glass having the above indicated composition into which a tungsten or molybdenum wire is sealed in the usual manner. A low expansion, boro-silicate glass of the above composition has a coefficient of expansion of about 3.5×10^{-6}. I have found that tungsten, W, or molybdenum, Mo, which has about the same coefficient of expansion is readily wet by this glass and may be used to make a perfectly gas-tight seal as described by me in my Patent No. 1,154,081.

In case it is desired to use a leading in wire consisting of platinum, it is necessary to join by fusion to the boro-silicate other glasses having a progressively higher coefficient of expansion until the coefficient of ordinary lead glass is approached. The seal may then be completed with ordinary lead glass

into which platinum wire may then be inserted by fusion in the ordinary manner. Glasses having these intermediate coefficients of expansion may be readily obtained in the market. Ordinarily it is desirable to use as many as three or even more layers of glass intermediate between the boro-silicate glass and the lead glass which has a coefficient of expansion of $9x10^{-6}$.

1. A tough, strong, glassy material consisting of combined basic material and the oxids of boron and silicon, the last oxid being materially in excess of 73%, said material having a thermal coefficient of expansion less than about $3.5x10^{-6}$.

2. A tough, strong glass consisting of the oxid of an alkali metal, magnesium, boron and silicon, the silicon dioxid being in excess of about 73%, said glass having a thermal coefficient of expansion less than $3.5x10^{-6}$.

No. 1,192,048. Glass Batch or Mixture. Elliott (Assigned to Macbeth-Evans Glass Co.), July 25, 1916.

This invention relates to an improved form of glass, having properties which give it special value for use in diffusing and distributing artificial light. These new and valuable properties are secured by the use of certain ingredients in the raw materials, or "batch" of which the glass is formed by the usual process of fusion.

A brief statement of the chemical and physical principles involved in glass making will facilitate a clear comprehension of the improvements which constitute my invention.

Glass, as known in commerce, is a mixture of silicates, holding more or less silica in solid solution, with the frequent presence of metals or elements in colloidal suspension.

The chief physical characteristics of clear or crystal glass are transparency, hardness, brittleness and elasticity. Its chief chemical characteristic is resistance to solvents.

Glass loses its transparency and assumes a white translucency under any one or more of the following conditions: (A) when one or both surfaces are roughened, causing diffuse reflection therefrom; (B) when minute globules or particles of air, gas, transparent crystals, or glass of different refractive index are distributed throughout the mass; (C) when particles of white matter more or less opaque are scattered through the mass. Glass known in commerce as "opal," "opalescent" and "alabaster," and used for the diffusion of artificial light, belong to class B, and are produced by the use of phosphates, or fluorids, in the "batch." It is well established that the minute particles above mentioned as producing glass "B" are ultra-microscopic in size, being comparable to wave lengths of light in their dimensions. This is proven by the fact that glass of this type shows selective absorption of transmitted light, the shorter waves being usually absorbed, thereby giving an orange color to the glass when thus viewed. This phenomenon is known in the industry as "firing." Such display of color is objectionable, but can be prevented in this type of glass only by increasing its density or opacity, *i. e.*, reducing the translucency of the glass, which is objectionable on account of greater absorption of light and consequent less efficiency. This type of glass also possesses a characteristic milk-white, glassy appearance by reflected light, strongly resembling glazed porcelain; whence it was formerly sold as "milk-china," is called "Milch-glass" in German, and is still frequently referred to as "porcelain" when in the form of a lamp shade.

In my improved glass I secure the following advantages: (A) complete elimination of "firing" due

to selective absorption; (B) substantially perfect diffusion of transmitted light with minimum absorption; (C) an apparent texture and color, both by transmitted and reflected light, almost exactly similar to natural alabaster, and free from the peculiar milk-glass quality. Such glass is pre-eminently suited to the production of bowls and plaques now largely used for semi-indirect lighting, and is also equally valuable for light-diffusing globes and shades.

I am aware that a glass resembling mine has been commercially produced, and is the subject of Letters Patent No. 1,097,600, dated May 19th, 1914; but this glass is objectionable for some purposes, in that visibly large particles or specks of a white opaque matter are scattered through it, which show as black spots and specks when the glass is seen by transmitted light. These specks are not present in glass produced from my improved batch. The glass above referred to also requires careful manipulation in the making, as set forth in the patent, whereas my batch requires no special treatment in the fusion.

I secure the peculiar qualities of my glass by a combination of methods B and C, hereinbefore described, *i. e.*, the matrix of clear glass has suspended therein glass particles of both ultra-microscopic and microscopic size. The ultra-microscopic particles change the glass matrix from a transparent to a translucent condition, while the microscopic particles prevent the selective absorption of the rays; the two effects combining to produce the alabaster appearance.

To produce the ultra-microscopic particles I use aluminum and fluorin compounds in certain proportions as hereinafter specified.

To produce the microscopic particles I use a sulfate. I have found that if sulfates be added to a batch adapted to form clear glass, the resultant product closely resembles the mineral known as moonstone. It is believed that the sulfate is not decom-

posed by the silica and alkalis forming such batch, and that the fine particles thereof are simply held in suspension, producing the effect above stated. If now, the density, or opacity, of such glass be slightly increased by the addition of the ultra-microscopic particles producible by the use of aluminum and fluorin compounds in certain proportions, the glass takes on all the desirable properties before enumerated.

I have found the following batch to give good results: (1) sand 700, soda 200, pearl ash 100, niter 50, antimony 10. To which I add: (2) feldspar 200, cryolite 55, aluminum sulfate 15.

Any batch capable of producing clear or colorless glass may be used in lieu of formula No. 1, as my improvement consists in adding to a batch adapted to produce clear or crystal glass, a sulfate, an aluminum compound and a fluorin compound.

It will be understood that the invention is not limited as regards the relative proportions of the sulfate and the aluminum and fluorin compounds, as good results can be obtained when the proportions of such ingredients vary widely from those stated. But it is preferred that the aluminum and fluorin compounds should be added in such relative proportions that the weight of the element fluorin in the batch should not be less than that of the element aluminum.

Any sulfate which will not be affected by or affect the silica and alkalis of the batch may be employed. Good results can be obtained in the use of sulfates of aluminum, magnesium, calcium, barium, strontium, lead, zinc, and other metals which will not produce color in the glass.

The sulfates may be added in any desired proportions from one per cent (1%) up of the total weight of the batch, since any excess will simply float on the surface of the molten glass as before stated.

It is old in the manufacture of opal glass to add barium sulfate or barium carbonate to the batch in order to increase the index or refraction, and there-

by the brilliancy of the resulting glass, but this effect cannot be produced in using barium sulfate unless the latter is discomposed by the use of a reducing agent, as charcoal. It is characteristic of my improvement that the sulfate is not reduced but remains in a state of suspension furnishing the microscopic particles found in the resulting glass.

I claim:

1. A batch for producing glass consisting of a foundation mixture capable when fused of producing a substantially colorless glass, combined with a sulfate which will not affect or be affected by silica and alkalis in the batch, and aluminum and fluorin compounds in such proportions that the weight of the element fluorin is not materially less than the weight of the element aluminum and free from any material tending to decompose the sulfate at the working temperature of a glass furnace.

2. A batch for producing glass consisting of a foundation mixture adapted to produce colorless glass, to which is added compounds containing a sulfate, which will not affect or be affected by silica and alkalis in the batch, compounds containing aluminum, and compounds containing fluorin, the total aluminum and fluorin contents being approximately equal in quantity and the sulfate being in such quantity as to leave suspended in the final melted mass undecomposed particles of sulfate, substantially as described.

No. 1,192,474. Glass. Taylor (Assigned to Corning Glass Works), July 25, 1916.

My invention relates to a composition for the production of a glass of a low expansion co-efficient, and inasmuch as one of the uses had in view for this glass is the manufacture from it of culinary vessels, my invention also contemplates the production of a glass of a low expansion and of high stability.

Glasses of very low co-efficient expansion can be obtained by formulae now known, but the difficulty experienced in such compositions is that if their expansion co-efficient is sufficiently low for the practical purposes, their temperature of fusing is so high as to preclude their economical working, and prevent their use for the manufacture of ware which I have in mind. I have discovered, however, that the addition of a small amount of lithia reduces the temperature of fusion of a glass mixture to a very great degree, and that this is so pronounced that although lithia has a high expansion factor, still it can be used in such small quantities as not to appreciably increase the expansion co-efficient of the mixture, while at the same time, materially reducing the fusing temperature. I have further discovered that lithia in the composition which I herein describe is of value in increasing the stability of the glass, although the glass herein referred to is a boro-silicate of very low expansion. Glasses of such compositions, especially when of high boric acid contents, are generally unstable, and subject to decomposition.

The following are examples of the compositions of several glasses made in accordance with this invention:

	A.	B.	C.
	%	%	%
SiO_2	71	75	70
B_2O_3	28	15	13
Li_2O	1	1	9
Al_2O_3		5	2
Na_2O		4	
Sb_2O_3			6

The expansion co-efficient of composition "A" above named, I have found to be .0000029, of B, .0000040, and of C, .0000056. It will be noted that all of the above compositions contain a comparatively large per cent of boric oxid; and that all of

them are boro-silicates. Glasses made from compositions of the formulae above given are extremely useful in the manufacture of glass articles exposed to extreme variation of temperature and to attacks by steam or other chemical action, this being by reason of their low co-efficient of expansion and their stability.

The presence of the alumina in compositions B and C is useful in preventing crystallization during melting and working.

I claim:

1. A glass containing silica, boric oxid and lithia, in the proportions specified, and having a co-efficient of expansion of less than .0000056.

2. A glass containing silica, boric oxid, lithia and alumina and having a co-efficient of expansion of less than .0000056.

No. 1,214,202. Glass. Macbeth (Assigned to Macbeth-Evans Co.), Jan. 30, 1917.

The invention relates to an improvement in glass intended primarily for use in the manufacture of blown illuminating ware such as shades, globes, and the like, although suitable for use in pressed ware both for illuminating and other purposes. The invention has for its principal objects; the provision of a glass which in light transmitting properties lies between milk glass which is too dense and glass made under my Reissue Patent No. 13,766, which is not dense enough where the shades or globes are thin and the light intense; the provision of a glass of the character specified which, when used in a thin shade, will present a white luminous appearance, permitting a proper illumination by the transmitted light without showing the illuminating element; and the provision of a glass which is cheap, easily worked, without a red or yellow tint, and capable of withstanding a very high temperature without breaking.

The foundation batch which I prefer to employ is as follows:

Sand	1000	parts
Potash	190	"
Zinc oxid	240	"
Borax	66	"
Salt	5	"

The foregoing batch, which aggregates about 1,500 parts, if used without coloring ingredients, will produce a substantially colorless clear glass. Various substitutes for the elements might be used to form this clear glass batch, but the ones given are preferred.

To the foregoing clear glass batch of 1,500 parts are added the coloring or opacifying ingredients comprising preferably the following compounds and quantities:

Hydrate of aluminum	190	parts
Fluorspar	135	"
Sodium silico fluorid	150	"

The clear glass batch with the foregoing coloring compounds are thoroughly mixed together and melted at a temperature of from 2,700° F. to 2,800° F.

The hydrate of aluminum ($Al_2H_6O_6$) contains 65.4% of oxid of aluminum (Al_2O_3) and the percentage of aluminum is 34.6%, so that the 190 parts of aluminum hydrate has an aluminum oxid content of 124.2 parts and an aluminum content of 65.7 parts. As the aluminum oxid is the coloring agent, other compounds containing the oxid, such as china clay and feldspar might be used instead of the hydrate, if an adjustment were made so as to secure the proper amount of the coloring agent.

The fluorspar (CaF_2) contains 48.7% of fluorin, so that in the 135 parts of fluorspar there is 65.7 parts of fluorin. Other fluorin compounds might be used, such as cryolite, if an adjustment were made to secure the proper amount of fluorin.

The sodium silico fluorid (Na_2SiF_6) contains 60.6% of fluorin so that in the 150 parts of this compound there are 90.9 parts of fluorin. Some other fluorid might possibly be substituted for the sodium silico fluorid if an adjustment were made to secure fluorin content in the fluorspar and sodium silico fluorid is 65.7 parts plus 90.9 parts or 156.6 parts.

It will be understood that, aside from the substitution of equivalent compounds for those above indicated, the proportions of the elements might be modified to a considerable extent and still produce substantially the same glass as that produced when the exact formula as above set forth, is employed. For instance, the aluminum oxid content may be varied between 80 and 160 parts, the fluorspar between 100 and 170 parts, and the sodium silico fluorid between 100 and 200 parts. The formula and proportions as above set forth, are, however, the ones which are preferred by me and which have produced the glass having the qualities referred to and also stated later. The glass as produced from the foregoing formula will stand a very high temperature without breaking, such quality being particularly advantageous when the glass is used in connection with high power nitrogen and gas lamps giving out an intense heat. The glass is also desirable with such high power illuminating elements since it diffuses the light without permitting the lighting element to be seen, and this is the case even with a relatively thin blown shade or globe. At the same time, the glass permits of the passage of a large percentage of the light so that a proper illumination is secured by the transmitted light, such as could not be secured with the relatively dense milk glasses heretofore known in the prior art. In appearance, the glass is white and luminous and without the objectionable yellow or brown tinge characteristic of opal glasses. The glass furthermore, is very easily worked and relatively cheap.

Claims:

1. A glass formed by fusing together a mixture containing approximately the following proportions: 1,500 parts of foundation batch capable of making substantially clear glass, 124 parts of aluminum oxid, 135 parts of fluorspar and 150 parts of sodium silico fluorid.

2. A glass formed by fusing together a mixture containing approximately the following proportions: 1,500 parts of foundation batch capable of making substantially clear glass, 124 parts of aluminum oxid, 135 parts of a fluorid containing about 50% by weight of fluorin, and 150 of sodium silico fluorid.

No. 1,234,457. Process of Making Window Glass and Hydrochloric Acid. Glaeser (Assigned to G. T. Bishop), July 24, 1917.

The present invention relates to a method of making window glass with hydrochloric acid as a by-product, or it may be considered as a method of making hydrochloric acid with window glass as a by-product, since in either case these two compounds are obtained from the present method. To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter set forth and particularly pointed out in the claim.

The following description sets forth in detail one approved method of carrying out the invention, such disclosed mode, however, constituting but one of the various ways in which the principle of the invention may be used.

The ordinary window glass is substantially a calcium-sodium-silicate, which is usually prepared by fusing a mixture of sand, lime or lime-stone, with sodium carbonate. I have found that by heating together in an open kiln a mixture of sand, lime or lime-stone, sodium chlorid, and coke in the presence of water and temperature of approximately 800° C. that a very good grade of window glass can be obtained, and

also a relatively pure hydrochloric acid. This mixture should be heated for about two hours at the highest temperature below which the sodium chlorid in the mixture will not fuse, which is approximately 800° C. under ordinary atmospheric conditions.

By the heating of this mixture the sand-calcium chlorid-coke mixture is completely decomposed with the formation of a calcium silicate and with the formation of hydrochloric acid gas, which is of course, given off. The various reactions which take place without the addition of coke during this heating may be illustrated as follows:

(1) $C+O=CO$
(2) $2NaCl+CO=Na_2O+Cl_2+C$
(3) $Cl_2+H_2O=2HCl+O$
(4) C (from (2))+O (from (3))=CO

Thus:

$$2SiO_2+CaO+2NaCl+C+O+H_2O= \\ CaSiO_3+Na_2SiO_3++2HCl+CO$$

Or the reactions may be indicated:

(1) $CaO+2NaCl=CaCl_2+Na_2O$
(2) $SiO_2+Na_2O=Na_2SiO_3$
(3) $C+O=CO$
(4) $CaCl_2+CO=CaO+Cl_2+C$
(5) $SiO_2+CaO=CaSiO_3$
(6) $Cl_2+H_2O=2HCl+O$
(7) C (from 4)+O (from 6)=CO

Thus:

$$2SiO_2+CaO+2NaCl+C+O+H_2O= \\ CaSiO_3+Na_2SiO_3++2HCl+CO$$

The addition of coke is essential in order to insure quick and complete decomposition of the salt. Without coke a higher temperature must be employed, but even then the decomposition proceeds only very slowly and is incomplete. In the former case the decomposi-

tion is effected by the action of the carbon monoxid formed upon sodium or calcium chlorid (compare with equations shown above); while in the latter case —if coke is omitted—decomposition of the chlorid is caused by the action of oxygen upon sand-sodium or calcium chlorid mixtures, as is shown by the following equations:

1. $CaO+2NaCl=CaCl+Na_2O$
2. $SiO_2+CaCl_2+O=CaSiO_3+Cl_2$

Or the reactions may be indicated:

1. $SiO_2+CaO=CaSiO_3$
2. $SiO_2+2NaCl+O=Na_2SiO_3+Cl_2$

I have found, as stated before, that carbon monoxid reacts upon sand—sodium chlorid mixtures much more quickly and efficiently than oxygen, insuring complete decomposition of the salt used.

It is not important as to whether lime or lime-stone be used in the mixture, the reactions being similar in either case, and if lime-stone is used carbonic acid being produced in addition to the other products.

The various amounts of each material which will be required in the mixture may be readily calculated from the foregoing reaction equations, but I have found that a suitable mixture consists of 100 parts sand, 41 parts sodium chlorid, 26 parts of lime-stone, and about 15 parts of coke, which will be mixed in any suitable apparatus such for example as the ball mill, and then slowly and continuously fed into a rotary kiln. If the kiln is not of the rotary type, then it will be necessary to supply some means for stirring or agitating the mixture during the heating in order to secure a homogeneous product.

As will be seen from the foregoing reaction equations, the chlorids are decomposed with the liberation of hydrochloric acid and the formation of free bases which combine at once with the sand to produce a

double silicate of sodium and calcium of substantially the same chemical composition as window glass. The exact composition may, of course, be varied by changing the proportions of the mass to be furnaced. The hydrochloric acid formed may be collected in suitable devices while the calcium sodium silicate is run into a glass melting furnace and fused.

The foregoing process is a simple one by which both hydrochloric acid and window glass may be produced from relatively inexpensive and abundant materials.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the process herein disclosed, provided the step or steps stated by the following claim or the equivalent of such stated step or steps be employed.

I claim:

In a process of making window glass, the step which consists in heating a mixture of sand, lime, sodium chlorid and carbon at a temperature of approximately 800° C. in the presence of steam in an open kiln.

No. 1,245,487. Opaque Semi-Translucent Glass. Miller (Assigned to Macbeth-Evans Glass Co.), Nov. 6, 1917.

This invention has reference to the production of a new opaque semi-translucent glass.

It is the object of my invention to produce a semi-opaque, semi-translucent glass by use of a new combination of ingredients fused upon a plan resulting in a new semi-opaque, semi-translucent glass.

The invention consists of a new semi-opaque, semi-translucent glass, produced by new ingredients combined in a novel way and fused in accordance with newly discovered procedure, which if followed, enables the color, texture and other properties of the

product to be controlled to a greater extent than heretofore. More particularly my invention consists in the use of a strontium-sulfur-oxygen compound in connection with a compound of an alkaline metal or earth with fluorin and a highly refractory material fused with the usual ingredients of a lead glass batch, substantially in the proportions and in the manner hereinafter more specifically described.

I have found that by the use of the usual batch for lead glass, consisting substantially of sand, soda and an oxid of lead, preferably red oxid of lead, with the usual and ordinary fluxes, together with sulfur-oxygen compound of one of the alkaline earths, preferably strontium; a compound of fluorin with a metal or alkaline earth, preferably sodium; and a refractory material melting only at a very high temperature; a semi-opaque, semi-translucent glass can be manufactured whose general color is white or whitish and without "the color" or "the fire" ordinarily present in commercial opal glasses.

I have found in the development of my invention that the use of compounds of sulfur and oxygen, with either calcium, strontium, barium or magnesium, when used in connection with the fluorin-metal, fluorin-alkaline compound in said lead batch, have specific effects upon the color of the resultant glass produced from their admixture and fusion. That when all of the ingredients are melted in a closed pot until complete fusion takes place, that the stability of the color or opacity and the translucency is affected according to the sulfur-oxygen-strontium and the fluorin-metal or alkaline earth compounds used, some of which give better results than others. The use of some of these combinations of ingredients permits of greater control of the batch and the resultant glass made therefrom than others. These results, to a great extent, depend upon whether sulfur and oxygen are used with calcium, strontium, barium or magnesium in combina-

tion with fluorin combined with an alkaline earth or calcium, sodium, lead, magnesium or other metal or fluorin injected into the glass batch by means of the mineral cryolite. The reactions of the sulfur-oxygen compounds are quicker with magnesium and calcium than with strontium and barium, whose reactions take place as to speed in the order named, the last being the slowest. The same is true with reference to the fluorin compounds, the reaction is quickest with calcium in combination with fluorin and slower with sodium, and with any other metal with which fluorin is combined which can be used for glass making purposes. I have found that when the melting points of the sulfur-oxygen and fluorin compounds most nearly approach the melting points of the refractory materials used, preferably china-clay or alumina, the better the resultant glass will be as to color, texture, fusion and working qualities when blown or pressed.

I have also found that by the use of a sulfur-oxygen-strontium compound in connection with a fluorin metal or alkaline earth compound and a refractory material of the character of china clay or alumina, that the color or opacity or the translucency of the resultant glass can be controlled to almost any desired degree, for the reason that when such a combination of ingredients is fused in connection with the ordinary lead batch containing the ordinary fluxes, the glass can be perfectly fused and kept in the melting pot for a longer melting period without losing its capacity, color and translucency (as is the case in ordinary semi-opaque, semi-translucent glasses), than when made with a lead batch and other combination of opacifying ingredients.

One of the formulas which will produce a semi-opaque, semi-translucent glass according to my invention, giving the ingredients thereof by weight, is substantially as follows:

Sand, 100 parts; soda ash, 49 parts; red oxid of lead, 56 parts; feldspar, 120 parts; sodium fluorid, 7 1/2 parts; strontium sulfate, 1 3/4 parts; sodium chlorid, 5 parts; alumina, 22 1/2 parts; niter, 5 parts; antimony, 1/2 part.

Without departing from the spirit of my invention, the quantities of the ingredients as above given may be varied; litharge may be substituted for red oxid of lead, with proper adjustment as to oxygen content; calcium fluorid may be substituted for sodium fluorid, but at a disadvantage as to control of specific effects; any of the alkaline earths may be substituted for strontium, but at a disadvantage; cryolite may be substituted for sodium fluorid; any flux that would perform the functions of sodium chlorid, niter and antimony may in like manner be used with similar results.

After the ingredients, as hereinbefore set forth, have been mixed, they are placed in a closed pot and heated until a complete fusion has taken place and when the desired color and opacity has been obtained, as may be ascertained by trials taken from time to time, the glass is taken down and worked in the ordinary way by blowing or pressing to produce the desired commercial articles therefrom.

The preferred batch set forth heretofore weighs all told 367.25 pounds and contains two aluminum compounds, feldspar ($AlKSi_3O_8$) and alumina (Al_2O_3). The percentage of aluminum in these two compounds is respectively 9.7% and 53%, so that the feldspar contains 11.64 pounds of aluminum and the alumina contains 11.92 pounds of aluminum. The total weight of aluminum is therefore 23.56 pounds, which is 6.41% of the total batch. The fluorin in the batch is carried by the sodium fluorid (NaF), the percentage of fluorin being 45.2% or 3.39 pounds, which is .92% of the total batch. The 1.75 pounds of strontium sulfate is equal to .47% of the batch,

and the sulfur contained therein is .08% of the total batch, while the 5 pounds of sodium chlorid is 1.36% of the total batch and the chlorin contained therein is .82% of the total batch. The aluminum, fluorin, sulfate and chlorid are the coloring agents and the foregoing percentages are set forth to indicate more clearly the relative proportions of these ingredients as compared with the total batch.

As heretofore set forth other substances containing the opacifying ingredients might be substituted if an adjustment is made to secure the proper quantity. The amount of the opacifying agents may also be varied between considerable limits depending upon the amount of color desired in the glass.

What I claim as my invention is:

1. A semi-opaque semi-translucent glass made by fusing together in a batch a substantially clear glass batch with aluminum, fluorin, chlorin and sulfur compounds.

2. A semi-opaque, semi-translucent glass made by fusing together in a batch a substantially clear glass batch with aluminum and fluorin compounds, a sulfate and a chlorid.

3. A semi-opaque, semi-translucent glass made by fusing together in a batch a substantially clear glass batch with compounds containing aluminum, fluorin, chlorin and a sulfate, with the aluminum in excess of the fluorin.

No. 1,261,015. Glass and Method of Making It. Enquist. Apr. 2, 1918.

This invention is intended to improve the strength, appearance and temper of glass, especially soda glass.

To the basic glass batch a certain proportion of lithia and potassa-bearing minerals, as lepidolite, is added. This serves to agitate and mix the batch.

I claim:

1. The method of making glass which consists in adding an appreciable quantity of lepidolite to a glass batch, and then fusing the batch thereby, to produce a glass in which the strength, temper and appearance thereof is increased.

No. 1,271,652. Method of Making Colored Glass. Bellamy. (Assigned to Western Electric Co.) July 9, 1918.

This invention relates to a method of making colored glass, and more particularly to the manufacture of ruby colored glass in which in the best known and commonest used processes gold is used for coloring material.

The principal object of this invention is to cheapen the process without deterioration of the product, by means of a reduction in the amount of gold required to satisfactorily color a given glass forming batch.

In accordance with the general features of this invention, the amount of gold required to satisfactorily color a given glass forming batch is reduced to a minimum by the introduction into the batch of tin oxid and a subsequent specific heat treatment of the batch.

The specific combination of the constituents of the glass forming batch hereinafter set forth is also believed to be novel.

The invention as hereinafter described may be readily utilized for producing glass of substantially any color, but is especially beneficial in the production of ruby colored glass. The introduction of the tin oxid into the glass batch serves to decrease the amount of coloring matter necessary to obtain a desired depth of color in the glass. As the more satisfactory forms of ruby colored glass are colored by the addition of gold, the reduction in the amount of this coloring matter for the production of ruby glass results in a marked economy, and consequently this invention is of a maximum benefit in the production of ruby glass.

The following description will consequently be confined to the method utilized for the production of ruby colored glass, but obviously the invention is not limited to the production of ruby colored glass, but is applicable to the production of all types of colored glass in which tin oxid is used in connection with the glass forming silicates, as hereinafter described.

The term ruby glass is applied to red glass colored by the use of copper, gold, selenium, and, in some cases, flowers of sulfur, the color of the glass varying very considerably in intensity and shade. The best ruby colored glass is obtained by the use of gold, the other substances enumerated above producing a glass having a color which is so dense that if the glass is of any material thickness, very little if any light will penetrate through it. For this reason the gold process is almost universally used when ruby glass having the required depth and uniformity of color is desired, and in the following description the invention will be applied to the production of colored glass by means of the gold process.

Generally speaking, glass consists of a mixture of two or more silicates united by fusion into a homogeneous, hard, brittle mass. Silica or sand usually predominates combined with the bases potash, soda, lime, lead, etc. Oxide and other materials are frequently used as auxiliaries to impart colors or otherwise alter the physical properties of the glass. There are eight classes of glass silicates in which silica is combined with some or all of the above-mentioned bases. A silicate of sodium or potassium containing a large percentage of lead is known as strass. This particular type of glass varies from colorless glass to a slightly straw colored glass if the percentage of lead is high, said color being due to the lead silicate. Strass glass is the only kind of glass which can be combined with gold to produce a ruby color. Glass made in accord-

ance with this invention consists of a glass batch containing the following ingredients given in percentage by weight:

Sand	36.30
Red lead	36.30
Nitrate of soda	16.00
Oxid of antimony	1.70
Borax	1.70
Oxid of tin	3.075
Potash	4.60
Lime	0.30
Gold (10 K)	0.025

These percentages may be slightly varied and satisfactory results obtained, although the preferred percenages above enumerated give the most satisfactory deep ruby transparent color. Gold is added to this glass batch as gold chlorid. This gold is added to the batch by dissolving 10 carat gold in aqua regia, which solution is stirred into the silica or sand, and in this way the gold chlorid is intimately incorporated in the batch.

The sand, red lead, nitrate of soda, oxid of antimony, borax, oxid of tin, potash, lime, and gold, which comprise the batch are then placed in a pot and heated to a very high temperature, about 2,400 degrees Fahrenheit, which causes them to undergo a violent chemical reaction. This chemical reaction results in the forming of complex silicates and the liberation of gases not needed in the compounds. When the chemical reaction has been completed and the evolved gases expelled from the hot solution transparent, viscous glass is formed. This transparent, viscous glass is strass glass holding in suspension gold and tin which have the potentiality of giving to said glass the ruby color if properly treated as hereinafter described. During the chemical reaction the gold chloride has been dissociated, leaving finely divided gold distributed through-

out the glass. A sample of the hot glass gathered from the pot at this stage of the operation is the color of strass glass, varying from a colorless to a slightly straw color. This glass is then allowed to cool, after which it is reheated to plasticity, at which time the color, due to the gold, develops, varying in intensity from a rose color to a dark ruby, depending upon the amount of gold present.

Various theories have been advanced to explain why finely divided gold homogeneously dissolved in glass assumes a ruby color under certain conditions. Ultra-microscopic tests show that on reheating the gold is converted into the collodial form of red gold hydrosol. Another theory is that on cooling glass quickly the gold separates out in particles of the magnitude of amicrons which are too small to reflect light and which by reheating, until the glass becomes soft, grow until they attain the size of ultra-microns which reflect the ruby color. As the ruby color is light reflected by particles of gold, the depth of color depends upon the amount of gold dissolved. In the well-known method of making ruby glass without the use of tin oxid one ounce of gold will produce the proper ruby color in sixty pounds of glass, the glass without the gold being transparent and reflecting no light. By reducing the transparency of the glass it was discovered that less gold would be needed, and the transparency of the glass was most efficiently and satisfactorily reduced by the addition of oxid of tin. A general law that a reduction in the transparency of the glass will reduce the amount of coloring matter required to color the glass any particular color desired seems to be substantiated by the experiments which have been conducted in connection with ruby, green and other colors. The oxid of tin added to the batch remains in suspension in the glass, producing opalescence, that is, the glass has a frosty straw colored appearance, and this opales-

cence assists in the reflection of the ruby color by the particles of gold to such an extent that one-fifth of the original amount of gold above referred to, with the proper amount of tin oxid added, gives the desired depth of ruby color. The tin oxid in addition to reducing the quantity of gold required also materially increases the strength and reduces the brittleness of the glass, which eliminates the usual annealing operation which is regularly performed on glass, the glass containing the tin oxid having a toughness equal to that of the ordinary run of glass which has been annealed.

Further, since the quantity of gold necessary to be carried in suspension to obtain the necessary depth of color is greatly decreased, the tendency of the glass to vary in color from the top to the bottom of the mixing and heating pot is very much lessened. The small amount of gold used in the improved process results in a more equalized distribution thereof through the mass of glass in the pot during the melting operation, said amount of gold being so minute that it has very little tendency to settle in the bottom of the pot. With larger quantities of gold, since the specific gravity of the gold is considerably greater than the mass of the batch, the gold tends to settle in the bottom of the pot and an unequal distribution of color through the mass in the pot results.

This equal distribution of the gold through the mass in the new process in which tin oxid is used permits of the successful manufacture of very small quantities of ruby glass. Quantities as small as ten pounds have been successfully made in which the glass has a very uniform color; whereas in the old process, in which the tin oxid is not used, satisfactory ruby glass could not be made in batches of less than 200 to 300 pounds. The improved process of making glass as hereinbefore described therefore results in a more economical production of a much better glass which has a greater uniformity of color.

Obviously this invention is not limited to the preferred method or article hereinbefore described, but is applicable to the production of all colors of glass, the production of which is included within the spirit and scope of the invention, as set forth in the appended claims:

Claims:

1. The process of making ruby colored glass, which consists in mixing a glass forming batch containing tin and gold with the usual glass forming silicates, heating said batch to substantially 2,400 degrees Fahrenheit, cooling said batch, and finally reheating it to plasticity.

2. The hereinbefore described process of making ruby colored glass, which consisted in combining sand, red lead, nitrate of soda, oxid of antimony, borax, oxid of tin, potash, lime and gold in proportions substantially as hereinbefore described.

No. 1,277,493. Manufacture of Glass. Sherwood. Sept. 3, 1918.

Niter cake, sodium hydrogen sulfate, is a by-product in the manufacture of nitric acid and its use in the arts is extremely limited, so that it is plentiful and is, in effect, a waste product.

The principal object of the present invention is to provide for industrially using niter cake, thereby converting this by-product, heretofore largely wasted, into a valuable raw material.

To this and other ends hereinafter set forth, the invention, stated in general terms, comprises the improvement in the manufacture of glass which consists in making glass with nitre cake as a fluxing or alkali component thereof, and my invention is based upon the discovery that this can be done by the conjoint use of carbon or carbonaceous matter and nitre cake in the batch or mixture from which the glass is made.

The production of glass by the use of nitre cake does not by any means simply involve the substitution of niter cake for fluxing components such as soda ash, sodium carbonate, or salt cake, sodium sulfate, for it is impossible to commercially make glass with nitre cake unless an appropriate amount of carbon is added to the mixture or batch from which the glass is made. Good results have been obtained by the use of carbon or carbonaceous matter in the form of pulverized bituminous coal. I have produced successful glass by the use of the following proportions in the batch or mixture; sand 45 per cent; niter cake 43.4 per cent; calcium oxid 6.4 per cent; and pulverized bituminous coal 5.2 per cent, but the invention is not limited to these proportions nor ingredients, since the point is that niter cake can be used in the batch or mix provided an appropriate proportion of carbon is present, which, generally speaking, is twice as much carbon as is used with normal sulfate to produce the same quality of glass in each case. From the proportions above given it appears that the amount of carbon is substantially twice what it would be in the case of the use of normal sulfate. I may say that, if desired, nitre cake and carbon can be used in association with other sodium components such as soda ash or salt cake. In accordance with custom any imperfections of color that may occur in the glass can be corrected in ways that are well understood by those skilled in the art.

I claim:

1. In the manufacture of glass a batch or mix containing niter cake and carbon amounting at least to 11% of the niter cake.

2. In the manufacture of glass a batch or mix containing niter cake and substantially twice as much carbon as is appropriate for normal sulfate.

British Patents.

1470 of 1855 to Margueritte.

Materials: Relates to the production of metallic silicates for the manufacture of glass and crystal. Silicate of lead, zinc, etc., prepared by heating the corresponding oxide with silica—is calcined with chloride of potassium, sodium, barium or calcium. A volatile metallic chloride is formed and may be condensed and then boiled with carbonate of lime, so as to form a metallic carbonate from which the silicate may be again prepared. A frit or residue is left after the expulsion of the volatile chlorides, and may be used for making glass. Glass and crystal may also be prepared by calcining suitable proportions of salt, silica and lime with kaolin or other clay. The hydrochloric acid evolved during the reaction may be collected and utilized.

1715 of 1855 to Paris.

Obtaining metal: Sulphate of lead is employed as a substitute, in whole or in part, for minium (red lead), in the manufacture of crystal, glass, enamel, or other vitreous products, the sulphates being converted to the oxide by charcoal or other reducing agent, during the manufacture of the frit, etc.

2371 of 1855 to Richardson.

Materials: Relates to the use of purified native borate of lime, either alone or fritted with soda in the form of carbonate as a substitute for borax in the manufacture of glass. The native mineral is levigated and a jet of steam is admitted into the dolly tub to promote the purification. Sand and other coarse impurities are separated in the dolly, and the finely divided borate flows on through spouts into settling tanks. The soluble impurities may be siphoned off. The purified borate may be dried at a gentle heat, being

occasionally agitated by the workman. For common glass it is sufficient to brush off the sand, etc., from the masses of mineral, or to expose them to a current of water. For pale glass, suitable for medicine bottles, etc., the crude borate may be used. A modification is described in which sulphate of soda is used instead of the carbonate.

2537 of 1855 to Margueritte.

Materials: Relates to the manufacture of glass, crystal, enamels, glazings and like vitreous compositions. Suitable proportions of the materials employed are given in the specification. A transparent glass, free from potash and soda, is obtained by calcining a mixture of silica, lime and alumina. Instead of employing pure materials a clay may be used, to which pure materials may be added as required, to obtain the desired relative proportions. It is stated that by this method with a clay of specified composition, a green-tinted glass is obtained, which might be used for making bottles, and that kaolin might be used for window glass, looking glass, etc. For making crystal, without potash, a mixture of silica, oxide of lead, lime and alumina is employed, the lime being substituted for the potash ordinarily used. Oxides of lead or zinc, etc., may also be added to this mixture. Felspar which contains potash or soda, or both these alkalies, is also employed for the manufacture of glass, the proportion of alumina being reduced, if necessary, by the addition of silica and lime. The proportion of alkali may be increased, if desired. To produce a vitreous product which may be used for the manufacture of crystal, the felspar may be calcined with metallic oxides, such as oxide of lead, the proportion of silica being increased by the addition of sand, etc. The addition of the other oxides, such as oxides of zinc or bismuth, produce a vitreous fusible, translucent ma-

terial. Other oxides may be added to tint the resulting product. Vitreous compounds are also obtained from phosphates, chiefly phosphate of lime, although biphosphates of potash, soda, baryta, strontia, magnesia, alumina, lead, zinc, cobalt and etc., may be used. The biphosphate may be vitrified alone, or in combination with alumina, silica, kaolin, clays, felspar, etc. The biphosphate of lime in such combination is stated to decompose salts and acids or other elements which can be volatilized, while it also serves as a decolorizing agent for contained iron. By employing biphosphate of lime, cheap substitutes for minium may be used, *e. g.*, sulphate of lead or zinc, and the arsenio-sulphides of cobalt and nickel, and other natural minerals may be substituted for artificial oxides. Tinted products, suitable for coating colorless crystal, or as enamels, are obtained by the addition of the oxides of cobalt, chromium, copper, uranium, etc.

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242 of 1856 to Chance.

Materials: Moulding, firing. Articles are moulded from pulverized vitreous matter, such as cullet or waste glass, with or without the addition of sand or other suitable material. The pulverized material is mixed with water to enable it to hold together, and it is then pressed into a mould of the required shape. When released from the mould the moulded article is carefully dried in a suitable kiln at a low temperature, and, when dry, is immersed in and covered over with sand, to regulate the heat and to support any parts which might give way during burning. The temperature of the kiln is then raised gradually, until the material is partially fused or agglomerated into a compact mass.

1204 of 1856 to Medlock.

Materials: Glass enamels and the other vitrified substances are made by fusing a clay containing from two to ten per cent of potash or soda, with such a pro-

portion of sand and lime, or carbonate of lime, as will produce with the constituents of clay, the definite chemical compounds known as double silicate. For the purpose of reducing contained iron to the lowest oxide, and so improving the color of the product, black marble, the color of which is produced by carbon, is substituted for the lime or carbonate of lime. Metallic oxide of the ores may be added to produce the required color and opacity of enamels, etc.

1515 of 1856 to Johnson.

Materials: Consists in using barium carbonate, obtained by decomposing barium sulphide in aqueous solution with carbon dioxide in the presence of potash. soda or other alkali, in the manufacture of glass and crystal, the compound partially or wholly replacing sodium or potassium carbonates in the production of silicates.

1813 of 1856 to Chamblant.

Obtaining Metal: Molten glass is mixed and treated by forcing air or gas through it whilst in the melting pot, by means of a platinum tube, fitted with a rose and connected by a flexible tube with a compression pump. When air is used it causes the oxidation of excess of carbon and etc., whilst hydrogen, carbonic oxide and etc. cause the reduction of sulphates, phosphates and other substances. Steam may be used to decompose or volatilize chlorides present in the glass in injurious proportions.

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595 of 1857 to Brooman.

Otaining Metal: Consists in making a sodium sulphate for use in the manufacture of glass, by treating sodium chloride, either in solution or placed in the flues of a furnace, with sulphurous acid; or, the sulphurous acid may be passed into a solution of sea salt. Sodium sulphite and hyposulphites are formed at the same time.

1197 of 1858 Bower.

Obtaining Metal: Powdered sulphate of barytes, silica or fine sand, and muriate of soda are calcined together at a strong red heat, until they become a dry powder. The compound thus formed, with the addition of the proper proportion of lime, is then converted into glass. If the glass is required to be colorless, the sulphate of barytes and sand are first purified with acid.

1129 of 1860 to Newton.

Materials: Oxide of zinc, used in combination with oxide of nickel, which acts as a decolorizing agent, is substituted for oxide of lead in the manufacture of flint glass, and is mixed in various proportions with silica and alkali to form the "batch" in the usual manner.

1732 of 1861 to Cobley.

Materials: Relates to the preparation of lead and barium silicofluorides which, with the corresponding silicates, may be used either conjointly or separately as enamels, glazes or pigments, in the manufacture of glass. Hydrofluosilic acid prepared by heating a mixture of finely ground fluospar and powdered sand, glass, flint, infusorial earth, slag or any native silicated base with sulphuric or other acid, is passed as gas into a solution of lead or barium salts containing hydrochloric, acetic or creosotic acid, or, the liquid acid is simply mixed with the metallic solution. The precipitate is either used in the state of pulp or is dried. Alternatively, the acid may saturate, oxides of lead or barium hydrate or carbonate, with or without boiling. Lead silicofluoride is also obtained by acting upon a lead silicate or a mixture of lead or slag or silica with liquid hydrofluoric acid; or, the acid gas may be passed into a condenser containing the finely powdered materials.

1005 of 1862 to Cobley and Wright.

Materials: The finely divided silicious residue from the metallurgical treatment of gold and silver ores is washed and used as a substitute for flint in the manufacture of glass.

2050 of 1862 to Gossage.

Materials: Sodium or potassium silicate for use in glass making is obtained by passing a mixture of furnace gases, air and steam, over solid sodium or potassium chloride, thereby volatilizing it, and then passing the mixed vapors through a granular mass or natural substance, such as flint nodules, granite or felspar, which contains silicon. This mass has previously been intensely heated by the passage of furnace gases mixed with air through it, and in consequence decomposition ensues, fluid silicate being dawn off from the furnace.

2187 of 1862 to Webb.

Materials: In obtaining metal for flint glass, sulphate or chloride of potassium is used in place of, or in combination, with the carbonate usually employed. In carrying out the process potassium sulphate, for example, mixed with sand or the like is fused, cooled, mixed with sand and metallic oxides and again fused. The first fusion may be facilitated by the addition of carbonaceous matters.

3080 of 1862 to Whitburn.

Obtaining Metal: English sand is purified for glass making purposes, by calcining or roasting it in open air stoves or ovens, which may be heated by the waste gases of furnaces, coke ovens, etc.

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878 of 1863 to Brooman.

Materials: In a process for obtaining barium oxides, a mixture is obtained containing zinc oxide and barium carbonate, which may be used in glass making.

5 of 1865 to Parker and Tanner.

Materials: A residue left in a retort when preparing oxygen, and consisting of a mixture of caustic soda and lime, may be used in glass making.

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897 of 1865 to Baugh:

Stained glass: Manganese oxide is added to the materials used in making glass for lamps and other reflectors, in order to give the glass a purple color. White arsenic or arsenious acid may also be added to give opacity. Platinum chloride solution is applied to the glass, which is heated in a muffle.

12220 of 1865 to Emerson and Fowler.

Obtaining Metal: Alkaline, earthy, or common metal oxides are fused with silicas, to form glass, and any well-known coloring materials may be added during the fusion. The materials are heated by a blast of air under pressure, which is gradually raised in temperature up to that of hot blasts used in blast furnaces for iron smelting. Metal obtained by remelting soda water bottles, etc., is used for casting mantlepieces, sinks, wash hand basins, monumental and other tablets, slabs, coffins, boxes, and other hollow articles and the linings for hollow articles.

1905 of 1865 to Chaudet.

Stained glass: Glass is colored by means of chromium oxide.

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200 of 1866 to Penney.

Materials: The ash resulting from the combustion of hoghead, cannel, and similar coals, shale, and the like, or the constituents of this ash, after treatment with acids, or the refuse silica from china clay, or other similar material, is used for making glass.

983 of 1866 to Johnson.

Obtaining Metal: White or semitransparent glass similar to enamel, milk, opal or alabaster glass, is made in the usual way from a mixture of the following ingredients: Double fluoride of aluminium and sodium, pearlash or soda, sand, chalk, saltpetre, and oxide of manganese.

2026 of 1866 to Newton.

Materials: Consists in making insoluble potassium or sodium silicates for the manufacture of glass by fusing together sand and the corresponding metallic nitrate or sulphate.

2593 of 1866 to Bousfield.

Materials: Manganese dioxide, as well as a mixture of oxide and sulphate of manganese, which have been recovered from chlorine still liquors and other solutions containing manganese, are employed in the manufacture of glass. The said liquors are treated with alkali waste, producing manganese sulphide, either alone or mixed with sulphur, and on roasting this precipitate, a residue containing oxide and sulphate of manganese is left. The residue, when heated with sodium nitrate in closed vessels, yields a mixture of manganese dioxide and sodium sulphate, which are separated by lixiviation with water.

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133 of 1867 to Weldon.

Materials for making glass. An artificial peroxide of manganese, containing over 55 per cent of dioxide and useful for glass manufacture, is made by injecting air into a mixture of a lower oxide of manganese and water. The air may be heated.

2114 of 1867 to Hargreaves.

Materials: Steel slag or the steel cinder obtained in making steel, etc., by the process described in the British Patent No. 2046, of 1867, is used in the manufacture of glass by fusing it with silica, lime and lead or zinc oxides or other glass making materials.

1854 of 1868 to Elsdon and Stein.

Materials; moulding: Glass making material consisting of silicious material and lime or other flux, or of materials which fuse into glass, is mixed with fuel and smelted in a blast cupola or other suitable furnace. Gaseous, instead of solid fuel may be used. The melted glass is run into moulds, to produce paving slabs, etc. A portable furnace may be used, the glass being run directly from it into trenches to form foundations for houses, or run between mould plates to form walls.

1920 of 1868 to Fleury.

Materials: A soluble silicon hydrate, made by heating silica or silicious materials in presence of sulphur and decomposing the resulting sulphides of silicon by water, is used in the manufacture of glass.

1972 of 1868 to Clark.

Kaolin, sand, grit, metallic oxides, and other material used for making glass are freed from iron oxides or other iron compounds by heating them to a red heat with ammonium chloride, or ammonia, or a material containing ammonia. The various vessels used are similarly treated, to free them from iron. By adopting this process of purification soda compounds may be used instead of potash, without producing a green color in the glass.

2277 of 1868 to Green.

Materials: Granular or talcose quartz, *i. e.,* quartz containing steatite or talc, is used as an ingredient in making flint glass.

3101 of 1868 to Archereau.

Obtaining metal: An intense heat for chemical, metallurgical and other purposes is obtained by burning a mixture of a combustible gas, such as carbonic oxide or hydrogen and a gaseous supporter of combustion, under a high pressure. Gases may be pumped along separate pipes into a mixing tube and then through perforations in the base of a crucible in which they are burned. This method may be applied for the manufacture of glass by heating in the crucible a mixture of potassium or sodium sulphate, silica and lime. Sulphurous acid and oxygen are given off, and the residue consists of glass.

3786 of 1868 to Prince.

Materials: Relates to the manufacture of a silicious material for the various purposes. Quartz or flint is powdered and mixed with gas-tar, petroleum or other carbonaceous substances or hydrocarbon. The mixture is moulded into small balls and heated in a crucible in a current of sulphur vapor, carbon bisulphide, or sulphuretted hydrogen. Silicon sulphide is thus obtained as a greyish-white powder which is decomposed by water, forming a solution of soluble silica and sulphuretted hydrogen. The sulphuretted hydrogen may be collected and used again and the solution of silica may be used as a material in the manufacture of glass.

2284 of 1870 to Balmain.

Materials: Caustic soda and potash are used in place of carbonates of those materials. They are mixed in the manner usual with the carbonates, or they are mixed roughly, the mixture being fritted and reground, or the alkali is previously fritted, melted or otherwise combined, with a portion of the ingredients, and the products subsequently mixed with the remainder.

1291 of 1871 to Richardson.

Materials for lenses for signal lamps. The glass is formed of 140 parts of sand, 10 of lime, 20 of fluor-spar and 60 of soda ash, with one of coal or coke dust as a coloring material; or, instead of carbon, iron and manganese may be used. The peculiar color produced may afterwards be changed into a more perfect ruby by staining.

1772 of 1871 to Wilson.

Stained glass; moulding, pressing: Tinted or colored lenses for spectacles or eyeglasses are made of uniform tint for different thicknesses by graduating the alloy or coloring matter, and are made to appear colorless to the wearer. Lighter and darker pink tints are obtained by mixing in various proportions white optical glass "manganese," and " chromium." The composition is cast in a mould, annealed, reheated and flattened endwise by pressure, and annealed again, and is ready to be worked into lenses. The method of pressing brings the grain into a position rendering the glass apparently colorless to the wearer.

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328 of 1873 to Smith.

Materials: Pure barium carbonate may be used, instead of oxide of lead, for making crystal.

3750 of 1873 to Britten.

Materials. Obtaining metal: Relates to the manufacture of glass for bottles, slabs, sheets, tiles, utensils, etc., from slag. The slag from the smelting of iron or other ores is mixed in the fused addition with sand, cullet, soda, potash or metallic oxides, the proportions varying with the quality and color of the glass required. To remove carbonaceous and other impurities, arsenic or mineral oxide may be employed and lead oxide, zinc oxide or barium oxide is used to facili-

tate the manipulation. Sodium sulphate mixed with ground coke or charcoal may also be added. The materials may be introduced in the form of powder or in the fused state, and the molten mass is either further heated in a stationary furnace, or run into vessels which may be lined with nonconducting materials, provided with furnaces and mounted on cylinders for conveying the metal to the glass works.

3007 of 1874 to Deane.

Materials: To manufacture artificial marble, lead oxide, sand, pearl ash, nitre, borax, white arsenic, and cryolite are mixed together and fused in a pot. The molten mass is then rolled upon an iron table and the slab produced is annealed in a furnace and may be afterwards ground and polished. The fused composition may be moulded in iron moulds.

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91 of 1875 to Mackay.

Materials: Spent bleach, soda lime, gas lime, tanner's lime, soap lime, and other waste lime products are mixed together with coal dust and waste alkaline liquors from paper, etc., works. The mixture is calcined in a kiln and then used in the manufacture of glass.

Sawdust, spent bark, etc., may be used instead of coal dust, and in some cases the addition of alkaline liquor is dispensed with.

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175 of 1875 to Vera.

Obtaining metal: A soluble glass made of sand, carbonate of potash and carbon is employed for electric insulation.

2669 of 1875. Heinzerling.

Materials: Residues obtained in the manufacture of potassium bichromate, iodine and bromine are used

for making common bottle glass. The residues contain ferric oxide, alkaline silicates, calcium sulphate, lime, magnesia, etc.

4017 of 1875 to Britten.

Obtaining metal: Glass is obtained from flint stones, quartz fragments, sand stone, or other suitable mineral, instead of from the sand or comminuted silica commonly used by heating a pile of the silicious stones in a suitable tank and introducing a more or less continuous supply of the fluxing ingredients. The tank is preferably made with a floor sloping down to a well, in which the glass collects as it runs from the stones.

2519 of 1876 to Johnson.

Obtaining Metal: When commercial nickel is melted with copper or other metal to form an alloy the composition of the fluxes employed is the same as the composition of bottle glass. The vitreous scoria obtained is pulverized in order to remove the grains of nickel by means of a magnet, and is afterwards melted in an ordinary glassmaker's crucible to manufacture bottle glass.

2950 of 1876 to Wallace.

Materials: Barium carbonate, obtained free from iron by a special process is stated to be applicable for the manufacture of cheap flint glass.

1701 of 1877 to Robbins.

A translucent material is formed of "pure silicate, silicate of soda or other silicate, as silicate precipitate, silica and silica precipitate, silex, quartz, glass, flux, felspar, lustres, etc., with paraffin, benzoline, liquid and crystalline, and also with the oxides as magnesite or zinc baryta, or the sulphates, carbonates, and other limes." These or other ingredients are mixed, ground, gauged and indurated as a cement with heat or chemi-

cals, and fired to flux or melt as enamels, lustres, glass, etc. The materials are treated with benzoline, paraffin, and other oils, which when heated throw off vapors from one or more furnaces, chambers, heating or other apparatus to pass into other chambers wherein the said fumes become condensed and fixed as material, otherwise formed into compounds of various kinds of enamels, glasses, lustres, fluxes, or other binders with which any downfall or other dust process or decoration may be employed. The material may be used for all purposes to which glass is applicable, as for lamps, shades, reflectors, ventilators, etc., also to form a double decorated surface with one or more patterns.

2527 of 1877 to Kew.

Obtaining Metal: Specially applicable for telegraph insulators. Each of the raw materials to be used is fired separately; they are then all ground and mixed together and again fired after which they are again ground. The materials thus treated may be used for the manufacture of telegraph insulators and other articles, either by subjecting to pressure, casting in moulds in a liquid state, or by throwing and turning; or, they may be fused in a glass furnace and blown into the required forms. Where only one material such as felspar, is used, the second firing may be dispensed with.

3280 of 1877 to Webb.

Iridescent glass producing: The glass articles are exposed, while in the nearly molten state after blowing, and before annealing, to the fumes generated by placing chloride of lime, alone or mixed with the nitrates of barium and strontium upon a hot plate or spoon. During this process the articles are placed in a muffle in which the fumes are introduced. The claim includes tin and other metallic salts, or their equivalent chemical compound.

4505 of 1877 to Wittman.

Iridescent glass is prepared by boiling glass in muriatic acid under great pressure and is employed for inlaying and decorating furniture, picture and mirror frames, albums, table ornaments, etc., whether of wood, glass, porcelain, leather or other material.

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459 of 1878 to Wirth.

Materials for making: Slag from blast furnaces is used as one of the raw materials. If solid it is pulverized by mechanical means; if hot, it is granulated by chilling with cold water, and afterwards dried. It may be used in a melted state as it comes from the furnace and placed in the melting pot in alternate layers with the other materials. The coloring due to oxides of iron or manganese can be destroyed if desired, by calcining the crushed or granulated slag.

2156 of 1878 to Sowerby.

Glass of a yellow opaque tint is made by adding uranium and cryolite to the ordinary constituents of flint glass, such as a mixture of sand, soda, barium carbonate, nitrate of soda, and manganese dioxide.

3403 of 1878 to Fleming.

Materials for making: A mixture of sand or silica, 17 parts; carbonate of soda, 4 parts; carbonate of baryta, 6 parts; borax, 2 parts; produces glass equal in clearness and brilliancy to the best flint glass.

3476 of 1878 to Lake.

Imitating marble: Material used is glass and the articles are cast in moulds or blown into the required form. The surface is then subjected to the action of the acids, or the sand blast, or ground to produce the desired effect. The veined and mottled markings are produced by adding coloring materials in the process of manufacture, the coloring matters being generally

metallic oxides. To imitate white or statuary marble an opaque glass is made from two parts of silica free from iron, 1 part of soda, and 3-7 per cent phosphate of lime; or a mixture of ten parts sand, 4 parts cryolite, and 1 part oxide of zinc may be used. The opaque black glass to imitate Belgian black marble is made of flint batch 600 parts, manganese 12 parts, oxides of iron 7 parts, zaffre 1/4 part. The invention is stated to be applicable to the manufacture of statues, medallions, statuettes, busts, urns, vases, and other works of art; cornices, brackets, balusters, balustrades, centre pieces, mouldings, pedestals, columns, altars, monuments, fountains, panels, mantelpieces, table and washstand slabs, wainscoting, ornamental tiling and caskets.

3727 of 1878 to Kempner.

Milk-tinted glass: In producing milky, alabaster-like, or milk colored glass, mixtures of felspar or felspar-like substances, fluor spar and heavy spar, or witherite, soda, potash and sand are used as substitutes for cryolite, tin oxide, and phosphate of lime.

4079 of 1878 to Pulvermacher.

Translucent medium for reflecting, refracting, and diffusing light. Consists in coating the interior surface of the glass, crystal, mica, or other material used with a layer of fine metal, preferably platinum, by chemical disposition and subsequent solidification. The application to globes, shades and reflectors for use with gas, electric or other lights, is mentioned while the provisional specification also states that glass so treated may be used for the windows of cabs and other transparent mirrors in partitions.

4880 of 1878 to Clark.

Metallizing glassware:

A reducing gas, such as hydrogen or coal gas is employed in blowing the glass and by its action on the

metallic oxides or salts contained in the glass reduces them to a metallic state on the interior surfaces. Thus when oxide of copper is used a golden or bronzed aspect is obtained from the reduced copper. Besides glass articles generally the following applications are specially mentioned: Stained window glass, glass plaques or tiles, reflectors, lighthouse lenses and glass for lighting apparatus generally.

4881 of 1878 to Clark.

"Metallized crackle" producing: A layer of glass containing an easily reducible compound such as oxide of copper, is placed between two other layers of glass. When the glass is partly blown it is dipped in water to crackle the surface. The blowing is then finished, when the middle layer of glass will project through the expanded cracks. These projecting veins are then metallized by exposing the article to a reducing gas such as hydrogen, carbonic oxide, or carburreted hydrogen. Successive layers of glass may be crackled and metallized in this way in different colors. Or the crackle may be made of granulated glass and the veins metallized as above. The ground only or both ground and veins may be metallized. By using clay masks portions only of the surface may be crackled. Vases, etc., in this way may have their interior surfaces mettalized according to the invention described in British Patent No. 4880 of 1878.

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53 of 1880 to Lake.

Obtaining Metal:

Calcium phosphate is substituted for its equivalent of lime in the ingredients used in making glass. The pot in which the materials are melted has in its cover a pipe of non-oxidizable metal, connected to a lead tube leading into water. "A narrow tube placed near the orifice of the crucible allows of the precipitation of the gases at the beginning of the operation by

throwing a small jet of water which is immediately vaporized." Hydrogen phosphide and phosphoric acid (the latter carried off by silicic acid of the sand) pass over on continuing the operation for a specified time, and form an acid liquor in the condenser, which may serve for repeated condensations, or be at once concentrated.

2342 of 1880 to Morgan-Brown.

Obtaining opalescent and iridescent effects in colored glass windows by use of opal glass: The latter material may be prepared from calcium phosphate or bone ash mixed with sand and potash together with salt, slaked lime, and broken glass; one or more of these being used. The milky appearance is produced by adding one or more of the following arsenic, tin peroxide, antimonic acid, and silver. The surface of the glass may be corrugated or roughened in moulds or be hammered, rolled, stamped or otherwise treated. In some cases the colored glass may be backed with one or more independent layers of opal glass.

3554 of 1880 to Parry and Colbey.

Glass, metals for making: A method of making various earthy silicates. Native silica, such as sand, silicious rock, or slag is fused with salt cake (sulphate of soda) and small coal in a furnace or in a glass-maker's pot. The silicate of soda formed is run into a receptacle and while hot a jet of steam is thrown on it, which will break it up; or it is allowed to cool and is broken up into pieces which are then steeped in water. The silicate is ground and heated with water under pressure. The solution obtained is removed and treated with caustic lime (milky lime) soluble sulphide of calcium, or caustic magnesia, or a mixture of these, till precipitation ceases. The liquid is then separated from the silicate by means of a filter press. The silicate of lime is used as a substitute for bone ash, ground flint, and glass, in the manufacture of porcelain and in the manufacture of glass.

5737 of 1881 to Hewitt.

Ornamenting glass by applying to it, while it is in a semi-fused state, finely divided metals such as copper, iron, zinc, or antimony, with certain salts or alkalies, enamels or caleareous substances, and, in some cases, oils or fats. The metals, enamels, etc., may be used singly or two or more together, but always with a salt, such as sodium chloride, or an alkali.

The whole is strongly heated and may be covered with a thin coat of glass. Or, a mixture of crystals of nitrates and chlorides of metal, such as gold and silver is placed in vessels in which a ball of glass metal is rolled. The mass is subjected to the action of carbonic acid, having in some cases, previously been "wasted" by immersion in water, and then reheated. Glass so ornamental is applicable for making vases, drinking glasses, bottles, wall decorations such as panels and dados, windows, tiles, plaques and door furniture, and for other purposes.

2278 of 1882 to Lake.

Materials: Impure sodium sulphate liquors, obtained in a process of making lead oxides and containing sodium sulphite and other sodium compounds are boiled down after removing arsenic and antimony, to yield a material for use in glass making.

3147 of 1882 to Harris.

Making colored glass for electric or other lamp globes, etc.: A ball of flint glass from the pot is mixed with a coloring composition and reheated. It is then placed in a cup of glass formed with an aperture in the bottom and the whole is welded together and blown. For transparent coloring, the composition consists of pigment mixed with a "fret" of sand, lead oxide, "potashes," and antimony. For opaque coloring, the fret consists of sand, lead oxide, arsenic and fluorspar. For opal effects, calcium phosphate is used instead of tin oxide, and red glass is obtained by substituting white lead for the lead oxide.

4131 of 1882 to Claus.

Materials: Silicates of zinc, lead, baryta, and strontia made by a special process, are stated to be applicable for use in the manufacture of glass.

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376 of 1883 to Herman.

Obtaining metal: Relates to methods of utilizing the refuse silicious materials from glass works. The waste materials are fine sand, after being used for grinding, used silica bricks, and flattening stones; the two last require to be crushed before being used. Glass of various colors may be prepared by mixing the refuse polishing-sand with the ingredients usually used in glassmaking. Slag from copper works, refuse from the soda ash manufacture (alkali waste), etc., may be used in addition to produce certain colors.

1557 of 1883 to Gatehouse.

Obtaining metal for glass bottles: Lignite or analagous substance such as brown or wood coal, is treated with a solution of soluble silicate or a mixture of silicious earths in powder, or as a slurry with or without the addition of soda ash, and when it is found to contain from 10 to 30 per cent of silicious matter it is distilled in a retort at a dull red heat. The residual "carbo-silicum" may be oxidized or calcined, and used in the manufacture of glass bottles.

2252 of 1883 to Colton.

Obtaining metal: Blast furnace slag, preferably of the uni-silicate type, is blown into slagwool by steam or air, the fibrous material thus obtained is pressed into crucibles, retorts, muffles, or ovens, with or without the addition of such substances as favor reduction, and is heated to redness till it is desulphurized, care being taken that the temperature is high enough to fret but not to fuse the mass. Dark colored particles are separated by scraping or washing, and are added

to the next charge, and the finished mass is pulverized for use. If the slag contains sulphate of lime this may be first reduced to sulphide. The material may be used as a glaze or a body in the manufacture of pottery, in the manufacture of glass, and for making ornamental plastering stucco, statuary and artificial stone in admixture with lime.

6889 of 1884 to Johnson.

Materials for opaque or opalescent glass: Instead of cryolite, etc., an alkaline fluoride together with kaolin is added to the ordinary materials used in glass manufacture. The fluoride may be conveniently formed by the addition of hydrofluoric acid to an alkaline aluminate. The following proportions are suitable: 38 parts of alkaline fluoride (containing 90 per cent of fluorides), 5 parts of soda, 15 parts of China clay, 10 parts of chalk, and 156 parts of sand.

13433 of 1884 to Stanford.

Transparent materials: Sodium alginate or alginic acid, obtained by special processes, when treated with an alkaline silicate forms flexible glass.

15743 of 1885 to Standen.

Obtaining metal: A mixture of sand, lime, or similar substances with metallic oxides and salts is dried, pressed and melted, and employed in the manufacture of bricks, tiles, etc., for sanitary use, building blocks, pipes, slabs and similar articles. Suitable proportions for tiles are 100 parts of white sand, 35 of lime, and 40 parts of sodium carbonate or other salt.

8023 of 1886 to Shirley.

Materials for opalescent or stained glass: Variously colored and translucent glass is prepared by adding a mixture of gold and uranium oxides, or gold with copper carbonate, or chromium oxides and litharge to

an aluminous batch. Articles made of this glass may be ornamented by removing the outer portion by sand blast in the usual manner, or by immersing them in a suitable bath, the parts of the surface required to be retained being protected by a suitable coating; or by applying enamel colors.

4821 of 1887 to Moore.

Materials for green opaque glass: To the ordinary opaque batch is added oxide or a salt of uranium and black oxide of copper, or (for a lighter color) peroxide of iron and black oxide of copper. Suitable proportions in the latter case are peroxide of iron 30 ozs., and black oxide of copper 6 ozs. to each cwt. of batch.

4822 of 1887 to Moore.

Materials for opaque glass: To the ordinary opaque batch is added flowers of sulphur, calcined oats, or other similar substance employed for giving ordinary glass a topaz color; a light brown or fawn-colored tint is thus obtained. About 8 ozs. of coloring matter to each cwt. of batch may be used.

5270 of 1888 to Chardonnet.

Transparent and translucent materials: Relates to a process for denitrating and dyeing pyroxylin for making glass substitutes, etc., which consists in immersing the pyroxylin in nitric acid. The reduction is accelerated by increasing the strength of the acid in the temperature. For example, the pyroxlin is heated to 30° to 40° C. with nitric acid s. g. 1.32 for 2-24 hours according to the thickness of the threads. The material which is thus rendered permeable is then washed and passed into a dye vat. When the process is also applied to the manufacture of flexible glass, or the like, the introduction into the mother solution of metallic chlorides for diminishing combustibility is dispensed with.

8129 of 1888 to Parry and Welsh.

Obtaining metal: Slate refuse or black-grit is pulverized and employed together with cullet and manganese or coloring oxides as material for the manufacture of glass articles.

11016 of 1888 to Hadden.

Materials: In forming red glass red oxide of copper and tin dioxide are added to the ordinary batch. The following proportions are used; sand 2,000, red lead 400, potash 600, lime 100, calcium phosphate 20, potassium bitartrate 20, borax 20, red oxide of copper 9, and tin dioxide 13.

13,211 of 1888 to Rust.

Materials for glass tiles: A mixture of sand, soda ash, native carbonate of baryta, China clay, phosphate of lime, nitrate of soda, and arsenic is fused, cooled, and powdered, and the powder is mixed with cullet and sand and returned to the furnace with the addition of metallic oxides for coloring purposes. The vitreous molten material is pressed in moulds and annealed in an oven.

2641 of 1889 to Davidson.

Materials: Articles such as ornamental dishes, vases, jugs, tumblers, etc., are made of clear glass at the base, the glass gradually becoming more opaque towards the top. To a batch of say, 560 lbs. of sand, 210 lbs. of alkali, and 84 lbs. of sodium nitrate, is added 70 lbs. of calcium phosphate, 84 lbs. of calcspar, and 35 lbs. of arsenic. The proportions of these three ingredients may be varied. The article is pressed and moulded in the ordinary manner, and then allowed to cool slightly and reheated.

2626 of 1890 to Huelser.

Materials: Opalescent glass is formed by adding silicofluorides of alkalies to any glass batch. The following mixture may be employed: cryolite, carbonate of soda, chalk, sand, kaolin, and silicofluoride of sodium. The cryolite may be replaced by additional silicofluoride of sodium.

16,629 of 1890 to Schulz.

Materials: Minerals, especially granulite or meldon stone, for use in the manufacture of glass and similar goods, are treated with acids, preferably hydrochloric, to remove any iron. The minerals are afterwards washed, and a little alkali added to neutralize any remaining acid.

2019 of 1891 to Walker.

Materials: Silicates for glass-making are obtained by steaming and heating a mixture of common sand and metallic chlorides, hydrochloric acid being given off during the operation. The sand is thoroughly pulverized and washed with hydrochloric acid, then mixed with chloride of calcium or sodium, or both, and replaced in a crucible arranged in a gas-fired regenerative furnace. Steam is introduced through a coil and perforated pipes and the hydrochloric acid escapes through a pipe. The crucible is mounted on a plate so that it may be lowered for emptying. The salt may be vaporized and blown into the crucible with the steam, or it may be fed from a hopper into the steam pipe and there vaporized. Steam may be passed through the bottom of the crucible, suitably perforated for the purpose. Other forms of furnaces may be employed. For glass-making, the silicates produced are mixed with cullet, or with carbonate and sulphate of soda, and pulverized coke or charcoal; or excess of sand may be used when producing the silicates, so that only the addition of carbonate of soda is required.

5324 of 1891 to Walker.

Materials: Relates to the process described in British Patent No. 2019 of 1891, and consists in the substitution of lime for the calcium chloride mentioned therein. According to the present process sand, which has been washed with hydrochloric acid, common salt, and lime are mixed and treated as previously described.

9,097 of 1891 to William.

Obtaining metal: The "Blacks" or pieces of glass removed from the blowing irons are usually treated with hydrochloric or other acid to remove the adherent iron scale. The present invention consists in heating the acid by means of steam jets forced into it, or by a fire placed under the acid bath, so as to increase the action of the acid on the scale.

21,350 or 1891 to Welz.

Stained glass: Relates to the manufacture of rose or orange-red glass. Selenium is added to the vitreous material while in the melting pot to produce rose and selenium mixed with cadmium sulphide is used for orange-red glass. The tint depends upon the amount of selenium or cadmium sulphide employed, and the greater the quantity of the latter used, the more the color inclines to orange yellow. Colored articles can be manufactured directly from the glass.

3,569 of 1892 to Cay.

Forming articles with portions of different refrangibility: Relates to the manufacture of globes, chimneys, and shades for electric and other lamps, the object being to diffuse the light and prevent the flame or electric filament from distressing the eye. Grains of colorless or colored sand, or other silicious material or glass, having a refractive power different from that of the material of which the chimneys, etc., are made, are introduced or imbedded in the main body

of the glass. A quantity of the body-glass is worked into the desired shape, and marvered on a marver on which the silicious particles have been evenly spread. The layer thus formed is then covered with an additional body-glass.

7,792 of 1892 to Grosse.

Marbled glass: Glass of any color preferably addled or opaque, is worked on the pipe as usual, and is then sprinkled over with a finely-pulverized colored glass flux by blowing, sieving, etc. The mass is then reheated in the furnace to fuse the flux, and is then finished in the usual way to produce sheet glass, etc.

8,865 of 1892 to Lewes.

Obtaining metal: In order to increase the rapidity of the fusion of the grit in the melting-pot, carbonaceous material, such as wood, charcoal, is mixed therewith. The combustion of the charcoal, etc., is effected by supplying air or oxygen (preferably heated) to it through suitable pipes of refractory material, or by using an alkaline nitrate, etc., in the grit in place of part of the carbonate usually employed.

2,033 of 1893 to Welz.

Materials for stained glass: Glass which appears orange yellow by transmitted light, and greenish by reflected light, is produced by adding selenium and oxide of uranium to the glass metal, while it is still in the melting pot.

4,273 of 1893 to Bohm.

Strengthening or stiffening thin-walled flexible fragile objects formed of glass, etc. The invention consists in placing on the inner or reversed side of the article a layer of soluble glass, barium sulphate or chalk, and sand or powdered glass, stone, or the like.

A coating of a solution of soluble glass serves to attach the two together. Before the article with its backing is perfectly dried, it is dipped into a solution of calcium chloride.

10,384 of 1893 to Solms-Baruth.

Materials; moulding: Relates to the production of glass resembling agate. A mixture of basalt, soda, borax, carbonate of lime, and sand with a small quantity of silver chloride is finely pulverized and fused in melting pots. Small pieces of basalt are gradually added and finally dichloride of tin is stirred in. After purification the glass is ready for working. The glass articles should be cooled irregularly, the more quickly cooled parts appearing the darkest. In order to effect the irregular cooling, porous wooden moulds are cooled by moistening with water, or metal moulds of varying thickness may be used. Or a mould constructed with vertical internal grooves and channels for the admission of a cooling liquid can be employed. By using metallic salts as fluxes, the color may be varied, for instance, copper suboxide and tin monoxide give a red or black ground color.

16,018 of 1893 to Kralik and Kralik.

Materials for stained glass: In place of coloring glass by the use of selenium, selenites or selenates are employed, these compounds being decomposed by the subsequent addition of reducing agents to the molten metal. Zinc dust is preferably used to reduce the selenium compound, arsenious acid, alkaline arsenites, or sulphate of soda, etc., are also applicable. A rose-red tint is obtained.

22,834 of 1894 to Soc. Anonyme etc.

Materials: Relates to the production of new opaline material by mixing about 54 parts of silica, 39 parts of baryta, and 7 parts of soda together. This composition is made into plates for covering walls, par-

titions in bathrooms, etc., or into vessels or other articles usually made of earthenware. The material may be employed rough or polished and can be ornamented or decorated by the ordinary process.

17,931 of 1895 to Ellis.

Obtaining metal: Glass is decolorized by the addition of selenium to it while the glass is in the molten state. The selenium may be added either in the metallic form or as a compound, such as selenate or selenide, in which case a suitable means of reduction for freeing the selenium is employed. Potash glass requires a smaller addition of selenium than soda glass. The selenium may be added after a preliminary decolorizing with nickel, saltpetre, arsenic, etc.

1,521 of 1896 to Wilsmore.

Materials: To render glass chimneys capable of emitting incandescent light when heated by ordinary lamp flames, particles or fibres of any substances which become incandescent under the action of heat are mixed or incorporated with, or affixed to, the glass forming the chimneys.

5,772 of 1896 to Garchey.

Moulding: Powdered glass, preferably that charged with lime and soda, is mixed with suitable coloring materials and placed in an iron mould box having a movable bottom capable of sustaining suitable pressure. The mould box is lined with sand, lime, etc. The mould is slowly heated till the glass is near its fusing point, in which condition it becomes devitrified. It is then heated to fusion, and the pasty glass moulded under pressure. The article is then removed from the mould and annealed. Marble is imitated by scattering over the pastry devitrified glass pieces of colored glass, which, when melted are stirred to and fro to form veins, the mass being then moulded under pressure.

22,511 of 1897 to Butterworth.

Forming articles with layers of diverse composition: Tubes for water gauges, thermometers, barometers, and other apparatus subject to high pressures or sudden or extreme variations of temperature are made as follows: A quantity of leadcasing glass is first gathered on the rod or tube, and over it is placed two layers of lime glass of which the inner may be intermediate in expansibility between the other two. A tube is then formed in the ordinary way from this composite metal.

2,003 of 1898 to Garchey.

Devitrified glass: Relates to a ceramic stone formed of devitrified glass, as described in British Patent No. 5,772 of 1896. Waste glass together with slag, scoriae, porter's and other clay, or other vitrifiable material is pulverized and sifted. When clay or other material not easily fusible is employed, the materials are agglutinated with a silicate or gum to form a paste that can be roughly moulded to the required form, but the powder may be placed in a refractory mould without any treatment. Fragments of unpulverized glass may be embedded in the pulverized material. The devitrification is effected in a furnace at a temperature below the fusing point of the materials, and the roughly moulded article is finally shaped under pressure between suitable dies. Molten glass may be run into moulds, devitrified, and finished in the above way. Pieces of colored glass embedded in the surface may be employed to give decorative effects.

1,880 of 1899 to Moser.

Materials: Relates to the decolorization of glass or neutralization of the green tint due to the presence of iron. A mixture of manganese peroxide, selenium, oxide of bismuth, nickelous hydrate, and arsenious acid is added to small quantity of the materials from

which the glass is made, and the mixture is introduced in which the melting pot after melting is proceeded to some extent in the furnace. Wet sticks of wood, etc., are introduced to produce ebullition and thoroughly mix the contents of the melting pot. Vitreous arsenious oxide may be added.

5,353 of 1899 to Herman.

Materials: Relates to the utilization of sand which has been employed for grinding plate glass, etc., and which in consequence contains both glass and iron finely diffused through it. The particles of metallic iron are removed from the sand either in the wet or dry state by the use of magnetic separators. The sand is graded, when mixed with water, by passing it through settling-pits from which the coarser grains may be returned to the grinding benches. The finer sand is dried in a hydro-extractor, or in a rotary furnace or otherwise, and is then treated with hydrochloric acid or other solvent or without the aid of heat. The recovery of the acid is effected by completely wetting the sand with the acid without using more than is required for that purpose, allowing water to run on the sand and drawing off the acid at the bottom of the vessel.

The water then takes the place of the acid without appreciably mixing with it, and as soon as water reaches the outlet the stream is diverted. If the sand is of the very finest grade, it may be necessary to remove the solvent and washing water by subsidence and decantation, or by a hydro-extractor, or coarse sand may be mixed with the fine sand to render it permeable. The product is well adapted for the manufacture of glass as it already contains a considerable proportion of the finest glass.

13,049 of 1899 to Walter and Walsh:

Materials; moulding: Copper or brass filings are melted with sand and soda to produce an opaque

golden-yellow glass called "aventurine" which is filled with specks or spangles of a bright gold color. In cooling, the mass breaks into a number of small pieces. Large aventurine articles are produced by welding, melting the fragments together in a mould, with or without the addition of other kind of colored glass. In order to prevent oxidation of the metal particles, the mould, muffles, kiln or oven is entered or closed to prevent access of air to the melted mass.

16,780 of 1899 to Rhoden.

Materials: Orthoclase felspar is mixed and heated to a bright yellow heat with lime and common salt and the soluble potassium salts obtained extracted. The residue, consisting approximately of 60 per cent of silica, 30 per cent of lime and 10 per cent of aluminum may be used for making glass.

16,781 of 1899 to Zsigmondy.

Ornamenting: Solutions for producing purple, vermillion, and rose lustre-colors on glass, etc., are prepared by mixing one part by weight of gold with from 0.2 parts by weight of silicic acid in the form of an organic silicide. The silicide solution is obtained by mixing an alcohol, essential oil, or solution of resin, or a mixture of liquids, with chloride of silicon, and evaporating the chlorine. Instead of the chloride of silicon, bromide, iodide, fluoride, oxychloride, or chloroform of silicon may be used, and a ketone, mercaptan, aldehyde, or non-saturated hydrocarbon may be substituted for the alcohol. The colors or tints may be varied by the addition of resinates or organic compounds of silver, lead, zinc, barium, strontium, calcium, bismuth, cerium or zirconium. The silvery lustre-colors are fixed by heating the article in closed muffle at a comparatively low temperature.

8,309 of 1900 to Knospel.

Materials: Barium, or barium compounds, such as carbonate, chlorate, hydrate, nitrate, oxide, or sul-

phate, are employed as fluxes, instead of potassium carbonate in making glass containing calcium phosphate, to be partially or wholly opaque and colored and easily moulded.

9,353 of 1900 to Ziegenbruck.

Ornamenting: Boracic solutions are added to pigments or glazes used in producing "lustre ware" and form borates when the articles are baked or fired. Cobalt lustre combined with the boracic solution will give a beautiful blue color enamel, while solutions containing gold will impart purple, red and pink colors to glass, etc. The boracic solution may be obtained from boron chloride and alcohol, or borax and ether sulphate, or by heating isobutylic alcohol with fused boracic acid, or otherwise.

18,152 of 1900 to Leuchs and Leuchs.

Coating: Relates to the manufacture of opaque or clouded glass or enamels by the employment of titanic acid. Burnt titanic acid, particularly that obtained by chemical means, is mixed or ground with finished glass or enamels, to form a compound which is applied as a coating to glassware, the coating being burnt on.

1,491 of 1901 to Sudre and Thierry.

Transparent materials: Pure, vitreous, amorphous, and homogeneous products for various purposes are obtained from natural or artificial oxides or mixtures or compounds of oxides with fusing points not less than that of pure alumina, by fusion in a vacuum or inert atmosphere under radiant heat of an electric furnace with one or more arcs, and out of contact with the electrodes. The materials treated include silica, alumina, lime, magnesia, glucina, rare earths, ferric oxide, zinc oxide and etc. chromite, aluminum, calcium, magnesium, etc., aluminates, calcined dolomite, bauxite, etc. After fusion, solidification is

effected by sudden cooling, as with cast iron or steel, and the cooled mass may be reheated, as with glass or malleable cast iron. The fused matters may be cast, rolled, stamped, forged, welded, blown, or drawn. Articles produced from these are almost insensible to temperature below the fusing point of iron and some of them acquire transparent and reflecting properties. The products may replace glass, crystal, porcelain, faience, earthenware, stoneware, and all the products of the glass making and ceramic arts. Metal also may be replaced when high temperatures, chemical action, or mechanical effects are to be resisted. Metallic skeleton or frame works may be embedded in the fused products for strength. Applications include fused silica for chemical vessels, carboys, retorts, crucibles, flasks, mortars, etc.

4,495 of 1901 to Geille.

Obtaining metal; moulding; ornamenting: Relates to the manufacture of decorative objects, such as plaques or facing blocks, from glass waste, etc. The waste glass is mixed with a compound composed of fluor spar, limestone, soda, and felspar, and the mixture is then heated until it is partly melted. It is then compressed in moulds of the required form. Broken glass is sometimes pressed into one of the faces of the article, to facilitate attachment to walls, etc. The right side of the article is heated, to render it more or less brilliant. Oxides may be added to the mixture to color it. In some cases, the face of the block is formed with a raised design, which is filled in with powdered colored glass, which is more fusible than the body and is applied by a sifter. The article is then heated to fuse the colored glass.

12,589 of 1901, to Garchey.

Devitrified glass; obtaining metal; moulding; ornamenting.—Relates to improvements in the manufac-

ture of the "glass stone" described in British Patents No. 5,772 of 1896, No. 2,003 of 1898, and No. 5,885 of 1900. Instead of preparing the glass stone from old glass, crushed or pulverized new glass is employed, which is poured into suitable moulds of thick metal, such as cast iron, and is transferred as soon as it becomes tacky or pasty, to moulds of sand, lime, plaster, talc, etc., placed in the rotary hearth of a devitrifying kiln or surface. Agrillaceous or calcareous sands may be added to the glass. When the sand mould containing the devitrified glass returns to its starting point in the kiln, the slab, etc., is removed and transferred to a hydraulic press, which gives it the exact form required. To ornament the surface of slabs, flags, or tiles, the bottom of the mould may be sprinkled with enamel powder or with glass fragments. The glass stone is well adapted to receive an electrolytic deposit of copper or other metal, which can be worked, polished, engraved, etc. The electrolytic process is applicable in the manufacture of electric insulators, condensers, electrodes, etc., from the glass stone.

5,242 of 1902, to Zsigmondy.

Stained glass; materials:—Relates to the manufacture of rich glass, in which the coloration is effected by gold; and consists in employing a glass composition containing a barium compound, and in using a quantity of gold not exceeding from .25 to 1.7 parts of gold for every ten thousand parts of silica present in the composition.

9,405 of 1902, to Becker.

Materials:—Relates to the utilization of glass-gall to obtain glass therefrom. A small quantity of graphite is added to the sulphate mixture, sufficient to reduce the sulphates in the glass-gall, but not in sufficient quantity to color the glass.

28,955 of 1902, to Becker.

Obtaining metal:—In order to prevent the crumbling, etc., of the mixture of raw materials when smelting by means of the electric arc, etc., they are first mixed into a paste with water, and then placed in a suitable vessel and dried at from 40° to 50° C.

10,040 of 1904, to Devillers.

Ornamenting:—Relates to the formation of imitating marble slabs, etc. Scales from small burst bubbles of colored glass, which has been refined in a liquid condition in an earthenware vessel, are applied to the surface of panes or sheets of window or other glass, being fixed on by cement. Liquid or powdered enamel with or without sand, is then sprinkled in, and the whole fixed at about 800° C., and cooled gradually. The imitation marble slabs formed are used for walls, chimneys, washstands, bricks, etc.

20,880 of 1904, to Bredel.

Obtaining metal; moulding:—In the manufacture of quartz glass, rock crystal, etc., is broken into small pieces, heated to about 1,000° C., and thrown into water. This is repeated in order to diminish the coefficient of expansion of the resulting glass. If quartz sand is employed, it is first melted and cooled, then treated as above. The material thus obtained is melted and transformed into a fibrous or woolly form by a jet of steam or hot air. The woolly mass is pressed or moulded into the required form, and remelted, preferably from the bottom in order to avoid the formation of air bubbles.

3,906 of 1905, to Johnson.

Obtaining metal; materials:—Relates to a process for obtaining quartz glass free from air bubbles from rock crystal. The crystal is broken into pieces about

the size of a hazel nut, and heated to a temperature somewhat above 600° C. The pieces are then removed singly, by heated tongs, etc., so as to avoid cooling, to an electric or oxyhydrogen furnace, where they are fused. In the case of an electric furnace, each piece is added only when the previous piece is fused, and in that of an oxyhydrogen furnace, the pieces are fused separately and brought together in the fused state.

15,375 of 1905, to Timm.

Obtaining metals. Relates to the preparation of blast furnace slag, for the manufacture of glass and the like, and consists in allowing the molten slag to flow downwards through a heated mass of the flux or other material with which it is to be admixed, so that a homogeneous solution of the latter takes place. A mixture of flux and coke is periodically introduced into a blast furnace through hoppers, while molten slag is continually admitted through a funnel, the contents of the furnace being maintained in an incandescent state. The material flows out through a passage. The most commonly used flux is lime, but ferric oxide, pyrolusite, alkali, and other substances may also be employed according to the nature of the material required. Gaseous or other fuel may be used instead of coke.

15,630 of 1905, to Bredel.

Obtaining metal:—Consists in a method of producing clear molten quartz at a low temperature. Quartz or other forms of silica that have been subjected to the preliminary treatment described in British Patent No. 20,880 of 1904, to prevent splitting when heat is applied is broken into small pieces and heated in a suitable vessel, such as a muffle or tube, to 1,200° C. by external heat. The object is to remove the air bubbles, which are present and which

retard the production of a clear liquid. For this purpose, a stream of hydrogen, or an oxyhydrogen flame containing an excess of hydrogen is introduced into the melting mass, which at 1,200° C. is permeable to hydrogen. The oxygen of the air bubbles combines with the hydrogen to form water, the vapor of which, together with the residual nitrogen, is expelled from the mass. At this stage an oxyhydrogen flame containing an excess of hydrogen is introduced into the mass, instead of the hydrogen or flame with excess of hydrogen the effect being to remove the hydrogen which was retained in this quartz. The temperature of the clear quartz is then about 1,950 to 2,000° C., or 300° lower than it can be obtained by the older process.

16,165 of 1906, to Jonkergouw and Destrez.

Moulding; obtaining metal; stained glass:—A mixture of sand, chalk, borax, minium and carbonate of soda, with or without the addition of metallic oxides for coloring is melted. The resulting mass is thrown into water, finely ground to a paste, and packed into moulds, which are then placed in a furnace till the materials are fused. Articles composed of several differently colored glasses may be made by packing each mould with several different pastes prepared as above described. The moulds are made of a mixture of clay, kaolin, quartz and burnt plaster in order to prevent the finished article from adhering.

5,123 of 1907, to Bloxam.

Obtaining metal:—In the manufacture of a ceramic material, a highly siliceous glass is first prepared by fusing together quartz, alkaline earths, lime, and products containing alumina, preferably in such proportions that the mass may contain not less than 75 per cent of silica, and not more than 10 per cent of alkali, 10 per cent of alumina, and 8 per cent of lime.

The glass is subsequently granulated and incorporated with other ingredients.

8,704 of 1907, to Lindemann.

Obtaining metal.—Glass which is transparent to X-rays and to light of very short wave-length, and hence specially adapted for the manufacture of Röntgen-ray and like optical apparatus is made by fusing a mixture of the oxides of elements having low atomic weights, preferably below twelve. For example, a mixture of the oxides of lithium, boron, and beryllium may be used. Borates, fluorides, or carbonates of such elements may also be employed. no silica used.

25,655 of 1907, to Seemen.

Obtaining metal:—Refractory oxides such as silica, alumina, magnesia, or lime or compounds of these are fixed with oxides of metals of the iron group or with titanium oxide in the presence of oxygen, to avoid contamination by reduction. The products, which are electrically conductive at ordinary temperatures, may be used for heating by electricity. The oxygen may be supplied by an oxidizing agent such as saltpetre, or in gaseous form. The mixtures may be natural or artificial, and may contain 15 per cent of iron oxide, 10 per cent of alumina, or 5 per cent of titanium oxide. An electric furnace is preferably used for the fusion. The specification in the original form as published under the act of 1901 states that manganese dioxide and zinc sulphate may be used as oxidizing agents; the oxides or metals of the iron group or of titanium may be used alone, metals may be used and oxidized in the fusion; and bodies of uniform chemical composition but of varying conductivity in different parts may be produced. This subject-matter does not appear in the complete specification.

15,963 of 1908, to Schanz.

Materials:—Glass to be used as a light filter to absorb ultra-violet rays contains chromium in small quantities, or lead in small quantities, and in addition uranium, copper, cadmium, iron, silver, gold, selenium, carbon or phosphorous. The whole of the ingredients may be added to a neutral glass, or two layers, one containing chromium, and the other the additional substances may be used, or neutral glass may be coated by "flashing."

14,761 of 1909, to Farjas.

Production of metal.—Radio-active glass is obtained by adding pure radium sulphate or sulphates or carbonates treated with radium to the materials used for glass-making. According to an example a transparent glass is obtained by melting together, barium sulphate treated with radium, silica, sulphur and fusible white glass; the sulphur may be replaced by charcoal; an opaque glass is obtained when a smaller proportion of silica is used. According to another example, barium carbonate treated with radium, silica, and fusible white glass are employed. The glass may be made into plates, tubes, filaments, etc., for medical and other purposes.

19,385 of 1909, to Rudolf.

Production of metal.—Opaque glass for making stoppers is produced by adding bone ash, Greenland cryolite, etc., to ordinary white or half-white glass while in a fused state.

19,908 of 1910, to Rible.

Production of metal; annealing.—Volcanic or other fusible rock is insufflated with air or gas when in a melted condition, so as to form pores in the material. Before the temperature has fallen to 500° C., the material is reheated and annealed at 800°

C.; it is then slowly cooled. Air may be introduced through tuyeres in the melting pot, or through quartz or other non-fusible pipes; or substances that produce gas at the temperature employed may be introduced into the molten mass suitable materials being carbonate of lime, bicarbonate of soda, gypsum, sawdust, carbon, graphite and some kinds of basalt. Crucibles made of or lined with plumbago, coke or carbon may be used to give the gas.

1,859 of 1911, to Kersten.

Production of metal.—Artificially manufactured alkali meta-silicates are added as fluxes to the constituent glass mixture in place of the usual alkali carbonates or sulphates. The alkali meta-silicates are obtained by dissolving crystalline silicic anhydride in alkali lyes under a pressure of about 25-30 atmospheres at a temperature of about 100-300° C.

16,603 of 1911, to Eddy.

Production of metal.—A small amount of a coloring material is incorporated in the glass of a backed mirror, to balance the other color components in the glass, whereby the selective absorption of this coloring material compensates for the selective reflection of the mirror, and tends to produce the image in which flesh color tints are sustained. A suitable glass may be made from 100 parts of white quartzose sand, free from iron, 33 parts of refined potash, 14.5 parts of slaked lime, 0.16 parts of manganese peroxide, 5 parts of litharge and 0.00002 part of purified gold chloride. The ingredients are fused, cast into a plate, annealed, ground, polished and silvered.

18,053 of 1911, to Burckhardt.

Production of metal.—Glass, similar in properties to silica glass, but more easily workable is produced by melting silica or pure natural quartz free from water, to which one or more acidic oxides of the

fourth group of the periodic system, for example, titanic acid or zirconium oxides, have been added.

26,091 of 1911, to Hailwood.

Forming articles with metal skeletons and the like.—A lamp glass for miners' safety lamps is strengthened by asbestos fibre, thread, etc., which is mingled with the glass while molten or semi-molten.

1,136 of 1912, to Vereinigte Chemische Fabriken Landau, Kreidl, Heller & Co.

Opaquing agents for white enamels, etc. consist of a hydrated compound of a suitable metal as tin, titanium, zirconium, aluminum, etc., containing a small amount of alkali or having part of the water of hydration removed.

16,787 of 1912, to Vereinigte Chemische Fabriken Landau, Kreidl, Heller & Co.

Production of metal.—Anhydrous zirconium compounds poor in alkali are prepared for use as cloudening-agents for white enamels, etc., by partially removing the combined alkali from alkaline zirconium compounds by means of a solution of a salt capable of reacting with the alkali and forming a soluble alkali salt; preferably the salt of a metal such as tin or aluminum, the oxide or hydroxide of which has a cloudening effect, is used. For example, zircon is partially or completely opened up by heating with sodium hydroxide or carbonate, and the soluble silicates and surplus alkali are then removed by means of water. The combined alkali is partially removed by treating the mass with ammonium, or metal salts, and the product is then heated until the water of hydration is removed.

18,300 of 1912, to British Thomson-Houston Co.

Production of metal; forming silica-glass articles:—Silica is added to sodium or potassium mag-

nesium-boro-silicate, known as "low-expansion glass," to form tough glasses containing over 73 per cent of silica having high melting points and low expansion and coefficients, for use particularly in making those parts of containers into which metallic conductors are to be sealed. Containers made of silica glass can be connected by intermediate layers of these glasses of graded composition and expansibility, to a pure-boro-silicate glass in which electric leading-in wires of tungsten or molybdenum make vacuum-tight seals; or the boro-silicate glass can be connected in turn by other known glasses to lead glass into which platinum wires may be sealed. A boro-silicate glass containing 71-72 parts of silica, 3-4 parts of magnesia, 11-12 parts of boric oxide, and 12-13 parts of sodium oxide, has a coefficient of expansion of $3.5x10^{6}$. Silica in percentages of 15, 30, 50, 70 and 85 may be added to form glass for use as intermediate layers between this glass and pure silica glass, and at least three further layers of greater expansibility should be used between this glass and lead glass having coefficient of expansion of $9x10^{6}$. Such layers may successively be fused on to a silica article by an oxygen blowpipe, or an electric arc.

19,849 of 1912, to Vereinigte Chemische Fabriken Landau, Kreidl, Heller & Co.

Production of metal.—Relates to hydrated or anhydrous metal compounds containing alkali for clouding white enamels, glass, etc., as described in British Patent No. 1,136 of 1912, and 16,787 of 1912, and consists in using from 2 to 7 per cent of alkali, the amount being preferably between 3 and 4 per cent.

25,238 of 1912, to Siemens-Schuckertwerke Ges.

Production of metal.—The reflector used with a projector such as an arc lamp is made of transparent glass having a coefficient of cubical expansion of less

than 2.5x10.5. A suitable glass is boro-silicate glass in which chalk and carbonate of soda are more or less replaced by boracic acid.

27,954 of 1912, to Rickmann.

Production of metal.—A mixture of an antimonate and antimony tetroxide is used as coloring agent for white glazes, glass and enamel. The mixture is formed by heating the metal antimony, antimony oxide, or antimony sulphide to incandescence with a saltpetre and alkaline hydrate so that part of the antimony is converted into antimonate, while the remainder is converted into tetroxide of antimony. For example, the antimony or antimony compound is heated in an open furnace with caustic soda and sodium nitrate or with caustic potash and potassium nitrate. The reaction product, after being washed and ground, is either added to the raw material forming the enamel and melted therewith or is ground with already melted enamel and the mixture again melted. Other white coloring agents may be used in addition to the above-mentioned substances.

29,382 of 1912, to Vereinigte Chemische Fabriken Landau, Kreidl, Heller & Co.

Production of metal.—In the manufacture of white enamel, glass, etc., wherein metal compounds poor in alkali, and in hydrated form are employed as cloudening agents as described in the parent specifications and in British Patent No. 19,849 of 1912, the amount of water and hydration contained in the hydrated oxide used as the opaquing agent is varied in inverse proportion to the percentage of alkali used. From 2 to 7 per cent of alkali may be used with hydrate water varying from 15 to 2 per cent. The invention is not applicable to tin compounds.

29,577 of 1912 to Siemens-Schuckertwerke. Ges.

Production of metal: The reflectors of projection apparatus are made from glass in which the capacity for resisting thermal effects is increased by the addition of boron or zinc, or both these substances.

7,864 of 1913, to Sanoscop. Glas Ges.

Production of metal: Glass having the property of absorbing the ultra-violet rays is produced by adding to the ordinary constituents of glass, rare earths of the series thorium, lanthanum, cerium, samarium, erbium, praseodymium and neodymium. Salts of heavy metals may be added in very small quantities to act as decolorizing agents. The glass may be used for spectacle and other lenses, lamp shades, mercury-vapour lamp bulbs.

12,626 of 1913 to Humann.

Production of metal: Sodium aluminium-fluoride $2Al_2 F_6 6Na F$, obtained by reacting on sodium fluosilicate with aluminium oxide or hydrate in the presence of an excess of hot water sufficient to dissolve the silica as a colloidal solution may be used as an ingredient of bone glass.

14,760 of 1914 to Boardman.

Production of metal: Screens or bulbs for electric incandescent lamps are made of glass which is tinted by adding to the glass batch or mixture black oxide of cobalt with about one-fourth its weight of calcined or oxidized iron, in order that the transmitted light may resemble daylight in tint.

10,161 of 1914 to Becker.

Production of metal. Crystalline glass products resembling stone, granite, etc., are manufactured by heating the raw materials for glass making (for instance sand, soda, lime, clay, etc.), until incipient fusion takes place, and then removing the mass from the

furnace or beyond the range of smelting temperature and coating or annealing as usual.

10,488 of 1914 to Davis.

Forming lenses: In the manufacture of colored lenses, plates, prisms, etc., more especially for railway, shipping, lighthouse and other like purposes, ordinary commercial colored sheet glass is coated with a thin layer of fusible siliceous compound consisting of silica, red lead, borax, pearlash, saltpetre or other like ingredients. The sheet is bent under heat to the required shape in a mould, during which process the cement is fused and forms a transparent coating on the glass. Molten clear white glass is then applied to the sheet and moulded to the required form.

20,827 of 1914 to Glasgow.

Production of metal. A glass for use as in color screens, electric lamps, shades, etc., comprises a single homegeneous glass containing nickel and copper, or cobalt or both. Potash lime glass is preferably used.

21,231 of 1914 to Craig.

Production of metal: The siliceous residues resulting from the treatment of bauxite or other aluminous ores, China clay, or calcined coal measure shales with sulphuric acid for obtaining aluminous compounds are utilized for the manufacture of glass. The residues are mixed with suitable material such as lime, calcium, etc. Sodium carbonate to neutralize the acid and other materials may be added.

11,083 of 1915 to Eyer.

Antimonates of alkaline earths, aluminum, magnesium, zinc, tin, zirconium, beryllium, etc., for use as clouding agents for enamels and glass, are produced by heating a mixture of antimony oxide and a metal oxide with ammonium nitrate until the ammonium nitrate is driven off.

100,738 of Aug. 16, 1916, to Corning Glass Works (assignees of Sullivan and Taylor).

Baking dishes, etc. are made of transparent glass with the under surface of the bottom slightly concave, and the upper surface quite flat. A number of components for sodium borosilicate glass suitable for the ware, and in which the percentage of silica is not less than 70 per cent of the total and the percentage of boric oxide to sodium oxide is not less than two to one, are described. Alumina may be present in an amount not exceeding 3 per cent of the total. Compositions are given in which the sodium oxide is replaced by potassium oxide or lithia.

101,685 of Nov. 29, 1916, to Strandh.

In manufacturing glass, particularly when the alkalis are added as sulphates, the batch mixture is divided into two portions, which are placed in the furnace separately, so that the first portion, which contains alkaline sulphates, silica, and carbonaceous matter, is melted before the second portion, containing, say, compounds of calcium and silica, is added. The alkaline sulphate is converted into silicate during the melting of the first portion, and the remaining portion is then added. A modified method is also described. Calcium carbonate, arsenious acid, or other gas producing substance may be added during the later stages of the melting to cause the mass to be stirred by the escaping gases.

German Patents.

No. 31,112. Process for producing milk glass or enamel by the addition of alkali fluorides. Tedesco. April 29, 1885.

Alkali fluorides are added to the glass mixture. The alkali fluoride is produced by treating alkalis such as alkaline carbonates with fluoric acid, or by the action of fluoric acid on an alkali aluminate.

In the first case it is preferable that the alkali should be in excess. When using this preparation, clay is also added to the glass.

In the second case, a mixture of alkali fluoride and clay is produced, which can be employed as such.

No. 33,425. Improvements in the process of producing milk glass or enamel by the addition of alkali fluoride. Tedesco. May 7, 1885.

This is an addition to German Patent No. 33,112.

Instead of the alkali fluorides mentioned in No. 33,112, the acid alkali fluorides are used.

No. 61,777. Process for producing milk glass. Kempner. May 18, 1892.

The sodium in the batch of glass is partially or entirely replaced by equivalent quantities of sodium or lead oxide, or about five per cent of clay or a clay compound, or boric acid are added.

No. 63,558. Process for producing rose-red and orange red glass. Welz. Aug. 24, 1892.

Selenium alone, or mixed with cadmium sulphide is added. In the first case a rose red color, in the second case an orange red color is produced.

No. 69,979. Process for the Manufacture of Milk Glass. Hirsch and Yedesco. Aug. 30, 1893.

Milk glasses to which cryolite or other fluorides have been added, together with clay, to make them translucent, become opaque after a short time, especially after heating. To prevent this aluminum, and carbon or substances that will produce carbon in the glass mixture, are added. This also conserves the pots.

No. 73,348. A process for making a glass, that has an orange-yellow color in transmitted light, and a greenish color in reflected light. Welz. March 21, 1894.

This is an addition to German Patent No. 63,558.

According to the main patent, selenium and cadmium sulphide are added to the glass in the pot to produce an orange red glass.

The cadmium sulphide is now replaced by uranium oxide.

No. 74,565. Process for Imparting a Red Color to Glass by Means of Selenites and Selenates. Spitzer. June 6, 1894.

This refers to the process of German Patent No. 63,558. A selenite or selenate (of potassium, sodium, or calcium) is added to the molten glass and the coloring selenium separated out by a known reducing agent as arsenious acid, etc.

No. 77,737. Process for imparting a red color to glass by means of selenium compounds. Spitzer. Dec. 12, 1894.

This is an addition to German Patent No. 74,565.

Selenium is now added to the glass instead of selenites and selenates. To secure new shades, gold, silver, coloring metallic oxides, bone, cryolite, etc., can be added.

No. 88.441. Process for producing a copper-ruby glass of any desired gradation of color. Goerisch & Co. Oct. 14, 1896.

Antimony is added to copper-ruby glass of any desired composition, to reduce the copper oxide found in the glass to the metallic state.

No. 88,615. Process for decolorizing glass by means of selenium and selenium compounds. Richter. Nov. 4, 1896.

Selenium or its compounds impart a rose red color to glass according to German Patents No. 63,558 and No. 74,565, when added to large quantities, but very small quantities thereof serve to decolorize glass. From 1-5 gms. of selenium are sufficient to decolorize a mass of glass, to which 100 kgs. of sand have been added.

The preliminary decolorizing of the glass can also be accomplished by the usual substances as manganese and saltpeter, and then the highest grade of white produced by selenium or its compounds.

99,165. Process for producing an opaque glassy flux. Dickmann and Rappo. Nov. 2, 1898.

For 5-25 per cent of the fluorides or silicio-fluorides of tin or cerium are added to the glass, according to the degree of opacity desired.

No. 103,441. Process for decolorizing glass. Drossbach. July 19, 1900.

Compounds of neodymium or erbium containing small quantities of cerium and praseodymium are added to the glass. The blue-green color of ordinary glass is removed by the rose red color of the erbium or neodymium.

No. 106,078. Asbestos glass and process of manufacture thereof. Sachsiche Glasswerke, etc., Jan. 17, 1900.

This consists of glass and an enclosed body or covering of woven textile fabric. The production is essentially the same as that of wire-glass. However it is necessary to fasten the asbestos fabric on stiff bodies made of paper or other burnable material, to give it the necessary hold.

108,595. Process for decoloring glass according to German Patent No. 88,615. Moser. April 19, 1900.

This enables the glass to be decolorized with certainty, and to then have a superior polish.

A mixture of 30 parts (by weight) of manganese dioxide, 25 part of selenium, 20 parts of bismuth oxide, 15 parts of nickel hydroxide and 10 parts of arsenious acid as used. This may be mixed with a batch of glass and added to the molten glass.

No. 126,728 Frit for the ordinary kinds of glass, especially for colored glass for bottles. Becker, Feb. 12, 1901.

In order to utilize the ashes of lignite or peat, these are added to the frit for ordinary kinds of glass in proportions which are regulated by the content of the ashes in compounds of calcium, iron, manganese, and clay.

133,502. Process for imparting a red color to glass by means of carbon. Meurer, Sept. 10, 1902.

Carbon in the form of carbon black is added to the glass. To prevent the creation of dust, the carbon black is pressed together, preferably with the addition of a binder, as sugar solution, etc. The pressed mass is ground to a powder which does not form dust, and is thus added to the glass. The carbon black can also

be saturated with melted alkaline salts or aqueous solutions thereof, and added to the glass after drying.

133,943. Process for producing glass made partially or completely opaque by means of calcium phosphate. Knöspel. Oct. 1, 1902.

In making such a glass the potassium carbonate of the batch of glass is replaced by barytes or its chemical compounds.

No. 138,281. Process for making heavy gold-ruby glass from batches of glass containing barytes. Zsigmondy, Feb. 11, 1903.

Enough dissolved or finely divided gold is added until 10,000 parts of sand have from 0.25 to 1.7 parts of gold by weight. Then the materials are melted in the glass oven. Sodium is suitable as the chief alkali, and barytes may be employed. A reducing means may be employed during the melting.

No. 162,607. Process for decolorizing masses of glass. Kersten, Oct. 11, 1905.

The decolorizing is accomplished by titanium compounds and a reducing agent.

No. 165,986. Process for Manufacturing Milk Glass, Kempner, Jan. 31, 1906.

The glass is made of sand, soda and feldspar poor in lime and sodium fluo-silicate in the proportion of two to one.

No. 182,266. Process for Manufacturing Dark Glass from Brown Coal Ashes. Allendorff, May 8, 1907.

The ashes are mixed with water in tall vessels so that their constituents separate in layers, according to their specific gravity. The magnesium compounds and clay are removed and the remaining mixture of iron oxide and lime as well as the necessary sand and other ingredients are made into glass.

No. 189,634. Process for Producing Translucent Glasses and enamels. Chemische Fabrik Gustrow, etc., Nov. 13, 1907.

This is done by the use of zirconium oxide or substances containing it.

No. 193,420. Process for Producing Dark Glass. Allendorff, Feb. 19, 1908.

This is an addition to German Patent No. 182,266. Peat ashes are subjected to the separation by the water instead of the brown coal ashes.

No. 193,421. Process for Producing Dark Glass from Brown Coal Ashes and Peat Ashes. Allen dorff, Feb. 19, 1908.

This is an addition to No. 182,266.

The clay and the magnesium compounds are separated by a flushing process before the dark glass is made.

No. 197,663. Process for Making a Dark Colored Glass Impervious to Actinic Rays. Sackur, June 24, 1908.

The glass is painted with a mixture of silver sulphide or silver sulphate or a mixture of both, and heated to 400-450° C.

No. 218,316. Process for Darkening Glass and Enamel. Lesmuller, March 2, 1910.

This is done by the oxides of quadrivalent elements as silicon, tin, lead, titanium, zirconium or thorium. These oxides are employed either singly or as mixtures, and are melted together with substances containing boric acid in such proportion that the melted boric acid is saturated with the said oxides. The melted substances are subjected to the action of steam or acid vapors while they cool, either when mixed with the glass or enamel, or else a dark borate glass can be first made and then added to the glass or enamel to be darkened.

No. 240,085. Glass. Stock, Nov. 29, 1911.

Rubidium is added to the glass.

No. 249,647. Process for Producing Melted Glass with the Use of Artificial Alkali Silicates as a Flux. Kersten, Aug. 28, 1912.

The alkali silicates are added in the form of alkali metasilicates, as the sole source of alkali. This is suitable for all kinds of glass, especially white glass.

No. 273,707. Process for Making a Glass Resistant to Chemicals. Schott and Gen., June, 4, 1914.

This is made of silicic acid, clay, lime, boric acid and 4-14 per cent alkali, in such mutual proportions that the entire quantity of clay and lime varies between half and five times the amount of boric acid.